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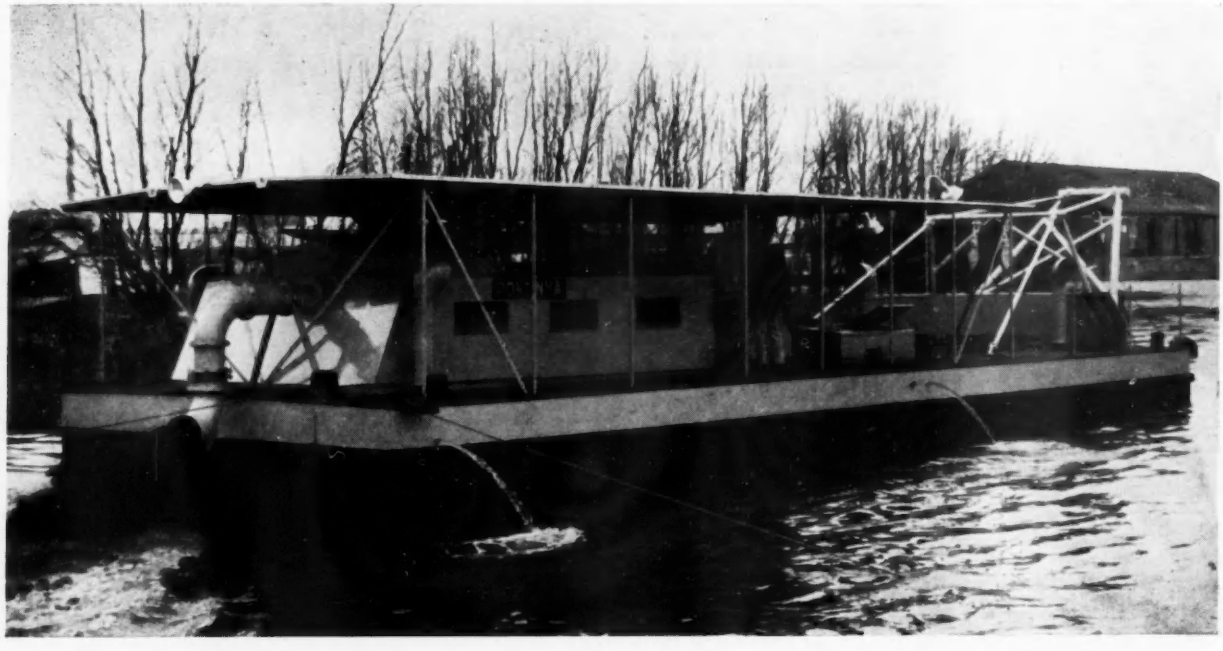

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|---|---|---|---|---|---|
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| Width (metres) | 4 | 4,50 | 5 | 6 | 7 |
| Depth (metres) | 1,50 | 1,50 | 1,80 | 1,80 | 1,80 |
| Draft app. (metres) | 0,65 | 0,70 | 0,80 | 0,80 | 0,75 |
| Max. cutter depth (metres) | 3,50 | 5 | 6 | 7 | 8 |
| Max. distance of discharge (metres) | 250 | 500 | 750 | 900 | 1000 |
| Max. height of discharge at max. distance (metres) | 3 | 3 | 3 | 3 | 3 |
| Mixture production at max. height and distance cbm/h. | 300 | 400 | 620 | 900 | 1200 |

| STANDARD SIZES | ZC 17½ | ZC 20 | ZC 25 | ZC 30 | ZC 35 |
|---|---|---|---|---|---|
| *Percentage of soil in mixture | 10-20 | 10-20 | 10-20 | 10-20 | 10-20 |
| Soil production at max. height and distance cbm/h. | 30-60 | 40-80 | 62-124 | 90-180 | 120-240 |
| Diameter suction pipe (cm.) | 20 | 25 | 30 | 35 | 40 |
| Diameter discharge pipe (cm.) | 17,5 | 20 | 25 | 30 | 35 |
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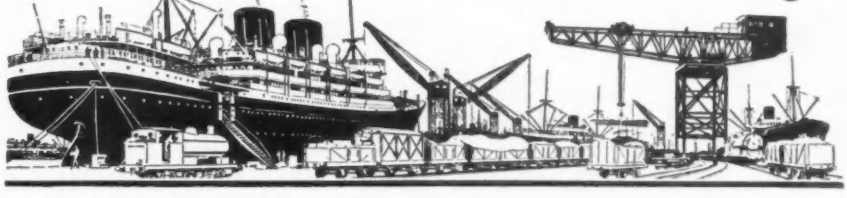

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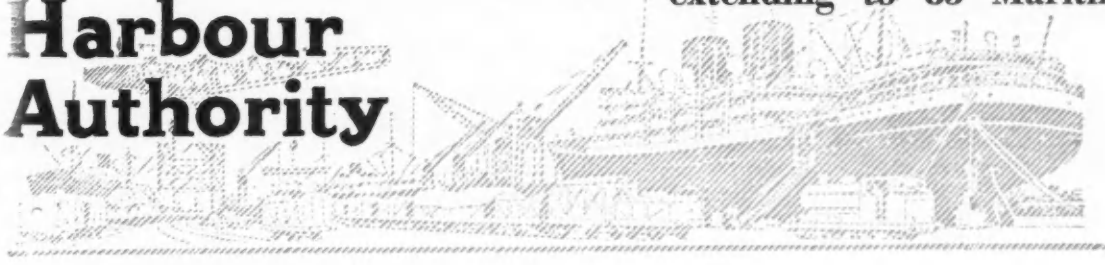


# Editorial Notes

### The Port of Arklow

The Port of Arklow Improvement Scheme described in a paper we print in this issue and the investigation work which has been carried out to ascertain what remedial measures might be adopted to arrest the long-term deterioration of a river estuary is a good example of the uncertainties which surround projects of this kind. Although much progress has been made in the general subject, particularly during the last 20 years or so, it is still not possible to give a definite answer as to whether under any circumstances an estuary could be improved. Rather is it a question of building up a background of knowledge by field-work combined with model studies and basic research in a variety of conditions, (as is being undertaken by the Hydraulics Research Station of DSIR and other agencies throughout the world) which should make it possible to foresee with increasing accuracy the best way to deal with individual cases. Ports have grown up over centuries and so have the vessels using them, but the rivers have not, and all too frequently earlier river training works and remedial measures designed to arrest inevitable deterioration have actually accelerated the process. The problem bears with especial weight on the smaller ports where the cost of improvement and/or dredging becomes an unduly heavy charge on the volume of cargo handled. Such reflections are clearly in the minds of the authorities at Arklow and, in the circumstances, it is natural and proper that they are preparing the way carefully and cautiously.

It seems probable that a considerable amount of river training has been carried out in the lower reaches of the Avoca river in earlier times. The river itself is the principal outlet for the run-off from the Wicklow Mountains catchment towards the Irish Sea and it would appear that the river flow is the dominant influence in the estuary and tidal action, the range of which in any case is small, is subordinated to it. Although mention is made of a northward littoral drift, the construction of the North and South Piers having been intended to prevent entry of sea-bed material, it is possible that the constriction at this point may have led to a loss of energy in the river flow upstream, causing heavy accretion at the site of the harbour installations. Borings taken in this neighbourhood show a 70-ft. depth of boulders, coarse and fine sand and silt overlying the bedrock. It is an unfortunate fact that improvement at one point in an estuary often produces deterioration at another together with a new cycle of changes which may have long-term adverse effect at the point where the improvements have been made. As a general rule the safest course is to keep an estuary as "free" as possible so that an overall regime can establish itself, with an optimum draught, but revets have been most successful where a particular configuration concentrates the scour of the ebb tide in the shortest duration. Where the ebb is longer than the flood the opposite effect is produced. With the presence of so many variables in the equation, however, the subject is full of complexities and pitfalls.

### Safety Precautions for Nuclear-Powered Ships

The report of the Committee appointed in 1958 to advise on the safety problems arising from the use of nuclear-powered merchant ships at sea and in port was published last February and abstracts from it will be found on a following page. The Minister of Transport has commented that the report contains a comprehensive survey on the measures required nationally and internationally to enable nuclear-powered ships to be operated with safety, particularly in the initial stages of development. The Committee's recommendations will provide an excellent basis for legislation in due course and, meanwhile, for international discussion at the Conference on Safety of Life at Sea which is to be held in London next month. The Minister also stated that the recommendations contained in the report would be discussed fully by his Department with the interests and authorities in Great Britain who are concerned. However, he agreed with the Committee that it would be premature at this stage to seek to lay down firm international regulations.

At the same time, it has been reported that Southampton Harbour Board have asked a sub-committee to consider the possible reception in the port of the U.S. nuclear-propelled merchant ship *Savannah*, or other vessels of similar type. The *Savannah* will be at sea during 1960 and may be expected to visit the United Kingdom late this year or early in 1961. It has been suggested to the sub-committee that it might wish to establish whether the *Savannah* was likely to call at the port and, if so, what expert advice could be made available about her and what organisation would be necessary for her reception.

Every major port will be sensible of the fact that this problem must be faced and prepared for as early as possible and the Southampton Harbour Board is only one of many who are giving consideration to the preparation of reception facilities for nuclear-powered ships.

### The St. Lawrence Seaway

With the opening to navigation this month of the locks and channels between Lake Ontario and Montreal, the St. Lawrence Seaway has commenced its second season as a major world shipping route. Much has been done during the closed season to iron out the difficulties encountered last year and it is confidently expected that ships will not experience the congestion and confusion that occurred during the height of the first season. There

are two main reasons for this, firstly, operators and users alike will have a better knowledge of the working of the Seaway and, secondly, there should be less " occasional " shipping using the route. Many of these latter that sailed the Seaway last year looking for trade will have withdrawn now that there has emerged a firmer pattern of the trade likely to be obtained from the Seaway ports.

Recently the annual report of the St. Lawrence Seaway Authority for the first season was published. This shows that there was a net operating income of $5,261,000 available for debt service. A payment of $5 mn. on account of interest was made last month.

Total income was $9,214,000 and administrative, operating and maintenance expenses amounted to $3,953,000. The applicable interest charge on loans from the Government of Canada was $7,994,000 and the amount by which interest charges were not earned was, therefore, $2,733,000 divided into two sections, Montreal to Lake Ontario $1,457,000, Welland Canal section $1,276,000. After making provision of $3,955,000 for depreciation, the accounts showed a loss of $6,688,000 for the period.

The final toll traffic figures show that there was an increase of 75 per cent in the cargo carried between Montreal and Lake Ontario as compared with 1958, the total being 20,590,000 tons. On the Welland Canal the total traffic was 27,530,000 tons, an increase of 29 per cent over the previous year.

The Authority reports that the major construction works have been completed except for the dredging of about 1,000,000 cu. yds. which will be completed this year. Total capital expenditures to December 31, 1959, stood at $310,650,000, including interest during construction (unpaid). Loans for construction purposes received and outstanding at the end of the year amounted to $285,500,000.

The report also gives an account of the management of the Lachine, Cornwall and Sault Ste. Marie canals which were entrusted to the Authority for operation from April 1, 1959, the expenses of which are recoverable from Parliamentary appropriations. Operating deficit and capital expenditures for the period were $1,655,000.

**Social Study of Dock Workers' Conditions**

The conditions under which dock workers in the ports of Amsterdam and Rotterdam live and work are to be studied by a special committee set up under the auspices of the sociological faculty of the university of Leyden. The faculty has been asked to undertake this investigation by the unions and the shipping companies and will be assisted in its work by the government department responsible for social affairs.

Inaugurating the study at a meeting held in the Hague recently, Prof. Van Heek, who is in charge of the inquiry, said: " We are concerned with making a study of the conditions in which men live and work and of the general social climate in the ports of Amsterdam and Rotterdam, and, as a result of this study, making recommendations for possible improvements."

The study is expected to take about two years and the committee will talk with dockers and employers in order to assess the " social climate ", and will compare conditions with those obtaining in ports in other countries. Among the aspects of dockers' work to be considered will be training for the job, wages, wage fixing and promotion opportunities.

**New Berth at Royal Victoria Dock, Port of London**

An important new two-ship berth, which the Port of London Authority have provided on the south side of the Victoria Dock, was officially opened on April 5th.

In order to accommodate two 10,000 tons ships and attendant barges the existing quay wall was extended to give a length of 1,160-ft. and a return quay 421-ft. long was constructed to serve as a barge berth. The peninsula to the south-west of the Connaught Road Cutting was entirely removed by dredging to facilitate the movement of ships between the cutting and the new berth.

A new transit shed 700-ft. long, with a clear span between supporting columns of 200-ft., has been provided to serve 2 ships. The framework of this shed—the largest in the Port of London—is of welded steel with a high proportion of tubes, and the roof and side cladding consists mainly of aluminium trough sheeting. There are 25 sliding doors, 20-ft. x 20-ft. constructed entirely of aluminium. Extensive covered loading bays are added at both ends of the shed to permit lorry working in any weather and clear of the rail tracks south of the shed. Loading platforms 20-ft. wide are provided at both ends and along the landward side.

The new quay is 50-ft. wide and carries four new 5-ton and three 3-ton 80-ft. radius electric cranes.

An open storage area, various ancillary buildings and a 2-storey office block complete the new berth.

The work was carried out by 3 main contractors, John Mowlem Ltd. (quays), Higgs and Hill Ltd. (general construction work) and Tubewrights Ltd. (transit shed superstructure). The new quay cranes were supplied by Stothert and Pitt Ltd. and the aluminium cladding by The British Aluminium Company Ltd.

The works were designed and constructed under the direction of Mr. G. A. Wilson, M.Eng., M.I.C.E., M.I.Mech.E., Chief Engineer of the Port of London Authority and were completed in 15 months at a total cost, inclusive of quay cranes, of approximately £770,000.

The berth will be used by the United States Shipping Line with whom the port of London Authority have concluded an agreement.

**Study of Waterfront Work Methods**

Modernised longshore work methods were tested earlier this year by United States scientists and engineers of the Maritime Cargo Transportation Conference, a part of the National Academy of Sciences—National Research Council. The tests, which were undertaken with the co-operation of the U.S. Navy at its Oakland Supply Centre, were an attempt to find what can be done to improve production and reduce waterfront cargo handling costs.

The Oakland experiments are part of a scientific study of the turnround time of general cargo ships which was begun in the San Francisco Bay Area two years ago by MCTC. Both labour and management are interested in the project.

The new work methods incorporate some of the latest types of powered handling equipment. They include an almost complete re-organisation of present work patterns and job assignment of longshore occupations. Besides reducing cargo handling costs, increasing production and reducing the arduousness of the work, economic gains are expected through a quicker turn round of ships in port.

MCTC has ben conducting research in various phases of shipping operations since 1953. It is supported by the Federal Government through a contract in which both the Departments of Defence and Commerce are parties, and it serves as an independent adviser to the Government on scientific and technical matters. It is a private non-profit making organisation dedicated to furthering science for the general welfare.

**P.I.A.N.C. Congress Proceedings**

We have been asked to state that a few copies of both the French and English editions of the Report of Proceedings of the XIXth Congress of the Permanent International Association of Navigation Congresses held in London in July 1957 are still available. The price is £2 2s. per volume (including postage) and enquiries should be addressed to The Institution of Civil Engineers, Great George Street, London, S.W.1.

# Port of Arklow Improvement Scheme

## Description of Harbour Development Works *

By R. P. McCABE, B.A., B.A.I., A.M.I.C.E., A.M.I.C.E.I.

THIS paper, in the first place, is a description of works carried out in connection with a harbour improvement scheme for the Port of Arklow in 1957; and in the second, it endeavours to enumerate some of the problems which confront harbour authorities in maintaining their harbours economically in present circumstances.

Some attention is focussed on the difficulties which arose during the construction of the works in the hope that these may prove of interest.

### Historical

Arklow is situated at the mouth of the Avoca River which, at this location, flows eastwards into the sea. Records of the town go back many centuries, but it was not until the dawn of the eighteenth century that the trade using the Port reached relatively large proportions.

There is evidence that the Port was used for the shipping of mineral ore from Avoca Mines from pre-Norman days. Iron ore was mined from the thirteenth to the eighteenth centuries, lead in the seventeenth and eighteenth, and copper in the early eighteenth century. In 1840, the technique for the manufacture of sulphuric acid from iron pyrites was evolved, which revived the Avoca Mines. This led to the first recorded development of the Harbour in the form of a river diversion to its present position. The work was carried out for the Wicklow Mining Company by " building quay walls on each side of the new river channel from Arklow Bridge to the sea." History does not relate the state of the Harbour before the diversion of the river; but we learn from the Arklow Harbour Act, 1882, that " the Harbour has of late years been gradually silting up, and a bar is frequently formed across the entrance thereto, whereby its value and usefulness are materially injured."

In 1882, the piers were extended further to sea in an endeavour to solve this problem. It was thought that by extending the piers further into the tide-way and by extending the south pier beyond that of the north, the silt would be diverted into deep water (see Fig. 1). The completion of these works, however, did not provide the solution expected. This presented a problem for trade using the port, which by 1900 had grown considerably—the principal industries being Kynochs Chemical Industry (which flourished between 1880 and 1920), mining and fishing. During this period, Kynochs Chemicals, in an endeavour to keep the bar open for shipping resorted to dredging. A small suction dredger of 60-ton hopper capacity known as " The Avoca " was used with some success. Dredging of a channel through the bar was begun each Summer in time to complete the operation before the advent of bad weather. Thus a navigable channel 8.0-ft. L.W.O.S.T. was maintained at the entrance to the Harbour.

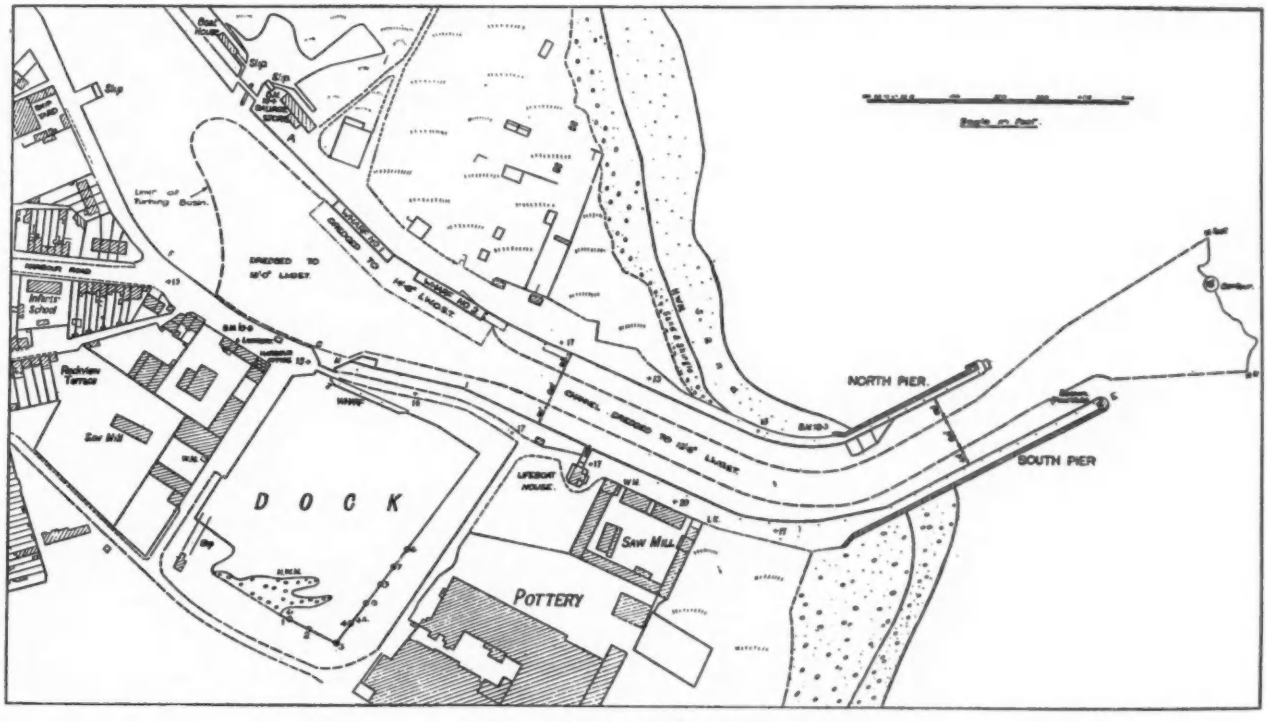



Fig. 1. Plan of Arklow Harbour.

Despite these difficulties trade in the port improved and the fishing fleet increased in number to become one of the largest in Ireland. Twenty-five motor fishing boats averaging 30 tons D.W. and of draughts ranging from 7-ft. 6-in. to 10-ft. 6-in. formed the basis of the fleet by 1950. Most of the vessels are built in the local shipyard of Messrs. John Tyrrell and Sons.

*Paper read at a meeting of the Institution of Civil Engineers of Ireland, December 1959, and reproduced by kind permission.

With the further passage of time and a continual neglect in normal maintenance of the Port the depth in the river decreased, while that on the bar perilously fluctuated with prevailing weather conditions. Silting within the Harbour increased through river-borne material being brought down by the Avoca river in times of flood and through finer material gaining access by way of the dock—the south side of which has yet to be completed (see Fig. 1).

From 1926 to 1948, dredging was financed from local subscriptions, little assistance was available from public funds so the extent of the work was restricted to the limit of the monies available.

The scheme, outlined below, had its inception in a decision by the Harbour Commissioners taken in July, 1956, to have a series of float surveys extending a mile north and south of the harbour mouth.

(b) Nature and distribution of sea-bed material. Samples were taken at regular intervals of time and place, and the pattern of particle size recorded.

(c) Rate of Silting. Forty-five separate soundings at the harbour entrance were carried out in the three years ending 1956.

The results of these investigations indicated that the pattern of silting on the bar conformed with certain laws which related to time and quantity. Moreover, it was realised that in the absence of more detailed information, treatment of the problem involving additional permanent works, could not be put forward with any degree of certainty. In this connection the use of a hydraulic model is essential.

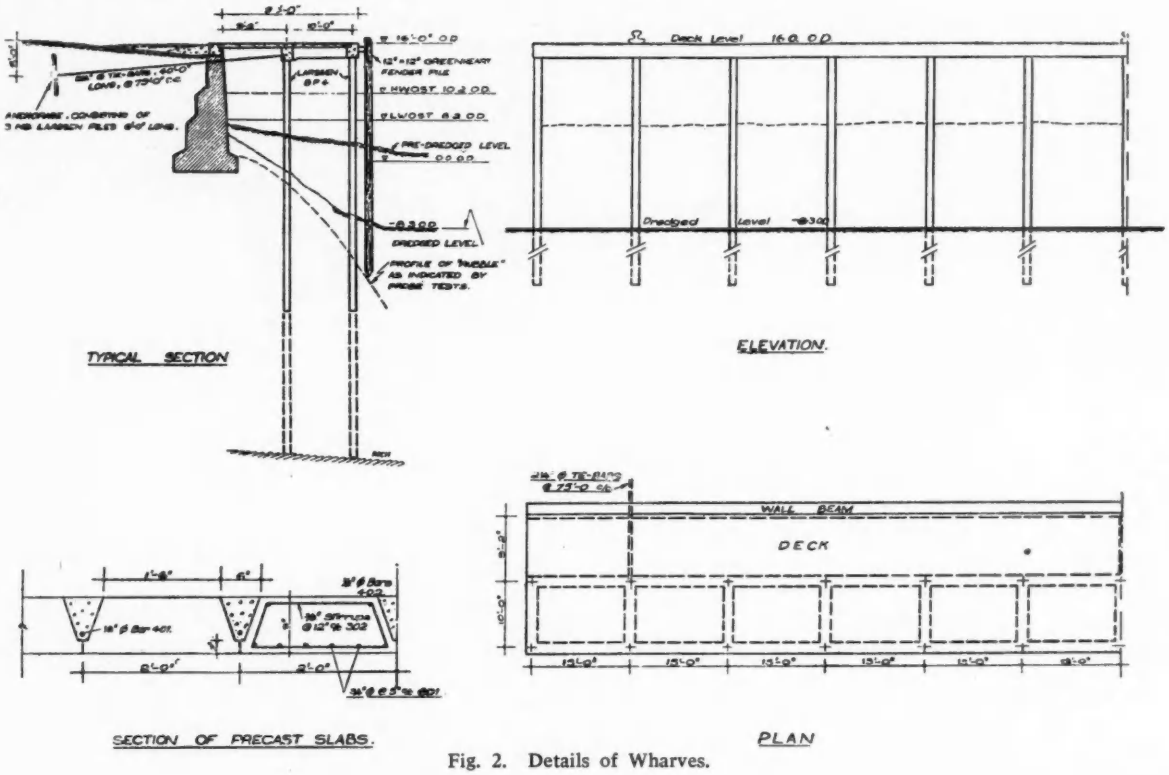



Fig. 2. Details of Wharves.

full investigation of the problem carried out and a scheme prepared for the development of the Harbour to cater for the shipment of mineral ore as a result of renewed activities in the Avoca Copper Mines. The investigation and subsequent design for this project were entrusted to the author and the late Mr. T. H. Delaney, B.A., B.A.I., A.M.I.C.E.I.

The navigable depth to which reference has already been made, presented the first problem in the satisfactory development of the port. An examination of available records of the port revealed a lack of factual information.

In 1953, a recommendation, which was agreed to, was made to the Harbour Commissioners to have a survey of the sea-bed in the immediate vicinity of the Harbour mouth put in hand. A hydrographic survey extending for a mile north and south of the pier heads and a half mile seawards was subsequently completed. This survey revealed no unusual pattern apart from the nature and extent of the bar.

In addition, the following investigations were undertaken to ascertain:

(a) Extent and magnitude of Littoral drift. This included a

Enquiries made revealed that the cost of building the necessary model for this investigation would be £12,000; and, as the total amount of capital available for the Improvement Scheme could not exceed £86,000 this investigation was postponed.

In view of the urgency for its completion, it was decided to proceed with the scheme on the basis that annual maintenance dredging of approximately 28,000 cu. yds. of sand will be necessary.

**Schemes Considered**

Several schemes were examined, taking into consideration operational requirements, future development of the port and cost.

The needs of the St. Patrick's Copper Mining Company were, in the first instance, to cater for 2,000-ton vessels entering and leaving the port at high water and for 1,000-ton vessels at all stages of the tide. As the average tidal range at Arklow is 3-ft., this involved dredging the river channel to 16-ft. L.W.O.S.T. (allowing a tolerance of 1-ft.) and stabilising the existing quay walls on both sides of the river.

The requirements of the ordinary traffic using the port—apart from mineral ore and fishing boats—is 10-ft. L.W.O.S.T.

One of the schemes considered was to complete the south wall of the dock, and to remove the North Wall separating it from the river to form a basin for additional berthage (see Fig. 1). The proposal had certain disadvantages. First, the dock area would be subjected to greater exposure, and secondly, the fishing fleet would have to vacate it during times of heavy traffic.

Aerial view of Arklow Harbour.

An alternative scheme, therefore, was considered which did not take the dock into account but provided deep-water berthage on the north side of the river, and turning basin up stream. It was proposed to stabilise the existing river walls by sheet piling before dredging the berths and basin.

Subsequent site investigations revealed that this scheme was not altogether feasible.

## Part I.—PILING CONTRACT

### Subsoil Investigation

Site investigation consisted of a series of probings and a trial bore. The probes were put down along the lines of the proposed piled walls—seven on the north side and seven on the south. Certain information was already available from six bores taken some years previously in the area for the Commissioners of Public Works. These bores were, on the average, taken down to −16.0 O.D., and consistently revealed sand and gravel.

On the south side no undue difficulty was experienced in driving the probes to a depth of −20.0 O.D. On the north side, however, it was found impossible to achieve a satisfactory penetration 5-ft. out from the quay wall. Refusal was reached in every case at −4.0 O.D. Probings were then taken across various sections of the river bed to reveal the extent of the formation responsible for refusal. The plotted results indicated that the river walls were founded on rubble mounds. This accorded with local belief, but it did not provide a satisfactory explanation having regard to the profile revealed on the south side. Examination of geological reports and surveys taken in conjunction with the local history of works in the area, indicated that rock formation was at a depth which would not interfere with the piling programme. The information revealed by the probings, however, necessitated some revision in the design of the berthage facilities on the north side of the river.

### Wharves

In view of the subsoil condition the proposal to drive steel sheet piling along the face of North Quay was abandoned. An alternative design was prepared comprising two wharves 80-ft. apart, each 182-ft. long and extending 21-ft. over the river. This layout was influenced by operational considerations and provided the maximum berthage with the finances available.

The design of each wharf was of open construction incorporating Larssen No. IV box piles 40-ft. long in bents at 15-ft. centres, and a deck consisting of longitudinal and tranverse reinforced concrete beams, cast in situ, supporting precast concrete units 8½-in. thick.

Each bent, consisting of two box piles and a tranverse concrete beam, was designed as a portal frame to resist a horizontal blow of 5 tons; resistance to glancing blows was also taken into account in the stiffening cross members. Pile spacing in each bent was to some extent influenced by constructional considerations, and the longitudinal beams designed continuous over supports to carry the outer track of the more common piling rig when in operation. The overall economy in design by so doing will be apparent (see Fig. 2).

The choice of steel box piles in preference to concrete piles was made primarily on account of the greater flexural properties of steel piles — an aspect of wharf or jetty design which, in the author's opinion, is often overlooked. The information gained during the probing tests made this choice a necessity. It was felt that the handling and pitching of the lighter form of pile would be reflected in the cost of driving, and when extending or cutting off to level, a considerable advantage.

The dock was designed for a superimposed load of 6 cwts./sq. ft., which involved axial pile loads up a maximum of 50 tons. Box piles, made up of Larssen No. IV section stitch welded together, were considered adequate to withstand the severe driving anticipated, and provide a sufficient margin of safety over and above this dead load.

Before the contract was placed, it was found that considerable quantities of second-hand Larssen piles Section III and IV were available at Dublin Port and Docks suitable for use in the various portions of the job. The Contractor was asked to purchase the quantity required, which resulted in a not inconsiderable saving in cost.

View of completed wharf.

### Stabilisation of Quay Walls—North Side

The form of construction of the quay walls at the wharves, together with the absence of more precise information regarding their foundations, made it necessary to increase their strength and stability.

While the information available indicated that the walls were founded on rubble mounds tipped in position on the gravel bed,

which in turn is under-layed by compact estuarine silt, the possibility of local failure by subsidence could not be discounted. Slip failure was considered remote. The problem was, therefore, one of providing the quay wall with adequate strength in the neighbourhood of the wharves so as to withstand the loads imposed during cargo handling. This was accomplished by filling the interstices between the stones forming the wall face with 1:2:4 concrete $\frac{3}{8}$-in. max. particle size from L.W.O.S.T. to quay level.

To achieve maximum concrete penetration, existing pointing to the stone work, which was generally in a poor condition, was taken out and the large cavities within the wall exposed. Shuttering was fixed at a clearance of 6-in. from the wall face and at a similar batter, and concrete of approximately 2-in. slump as poured in lifts of 4-ft. It was then vibrated until it slumped to a level of approximately 2-ft. within the shutter.

The wall in this way was dosed with $\frac{1}{2}$ cu. yd. of concrete per sq. yd. of face. Subsequent test openings made in the work showed that the system worked extremely well.

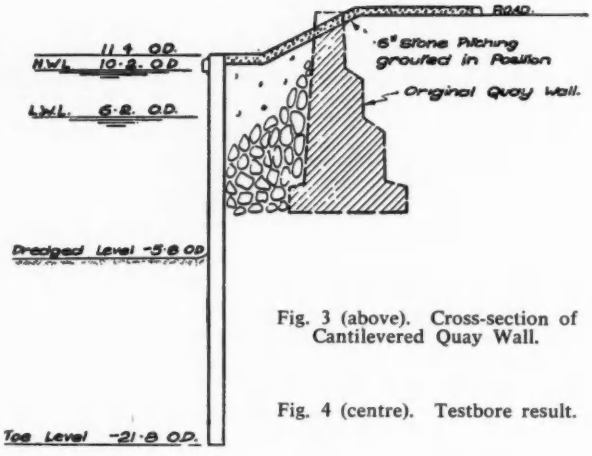



Fig. 3 (above). Cross-section of Cantilevered Quay Wall.

Fig. 4 (centre). Testbore result.

### Sheet Piled Walls

The information revealed by the trial probes on the south side of the river indicated that no undue difficulty would arise when sheet piling there. The design for this portion of the scheme was therefore unaltered.

The form of construction consists of a cantilevered sheet piled wall driven to a uniform top level of 11.40 O.D. and a toe level of −21.8 O.D. Dredged level is approximately −5.8 O.D. Larssen No. 2 section was adequate here but Larssen No. 3 was considered the minimum in marine works for this purpose (see Fig. 3).

### Construction

Driving of box piles on the north side commenced in June; sheet piling on the south side commenced some weeks later. The set specified in the case of box piles was 24 blows in the last 3 inches with a drop hammer weighing three tons and falling through 3-ft. It was subsequently found more convenient to alter the set to one of 100 blows in the last foot of penetration to avoid error in identifying set from local or erratic increase in driving resistance.

The first box pile punched through the rubble tip foundations of the wall without gaining the set specified. Having done so, which was at a depth of penetration of 11-ft., driving resistance decreased. Driving was continued to H.W.O.S.T., a forty-foot extension was spliced on and driving resumed. Set was established at 54-ft. penetration. The second pile driven behaved similarly.

From the experience gained, it was thought that set might be attained at a lesser depth if the driving resistance was artificially increased for the remainder of the piles. It was hoped to achieve this by closing the open ends of the piles.

Before proceeding, the subsoil in the immediate vicinity was investigated. A test bore was put down between the wharves and disturbed and undisturbed samples taken (Fig. 4). The results showed that the material on which the piles had set was compact material estuarine silt—the over burden being made up of less

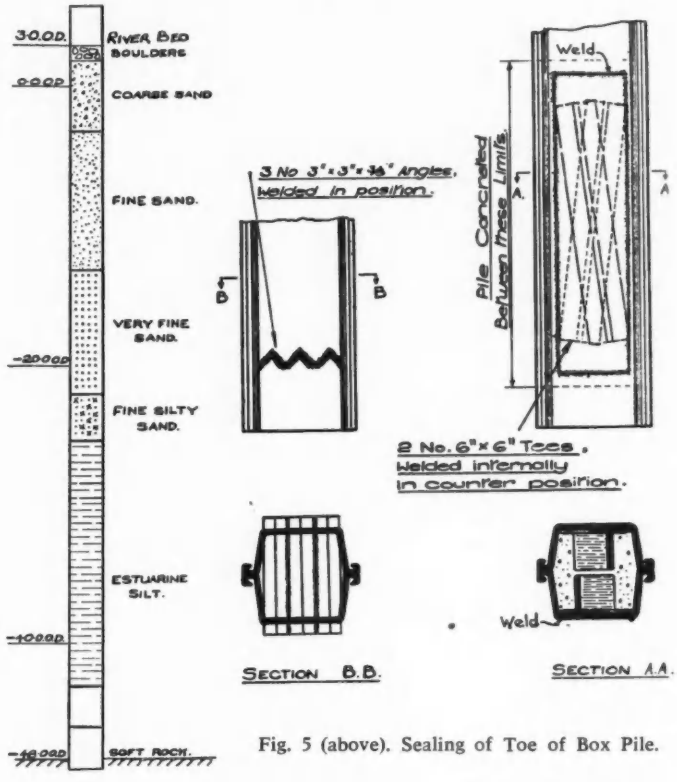



Fig. 5 (above). Sealing of Toe of Box Pile.

compact, of a sand and gravel nature. There was no evidence of clay.

Accordingly, two piles were driven in position with the ends closed. The first of these piles (No. 3, Wharf No. 1) was sealed 12 inches from the bottom with 3 No. 3-in. x 3-in. x $\frac{3}{8}$-in. mild steel angle threaded through slots burned to profile on opposite webs of the pile. The projecting ends of the angles were then carefully welded in position (Fig. 5).

A marked increase in driving resistance was noted in this pile while being driven to a depth estimated to be half way through the rubble foundations to the walls. A sudden yield was then noted and resistance to driving decreased. Dippings taken revealed that the plug had failed. A second pile was sealed by introducing 2 No. 6-in. x 6-in. tee pieces 36-in. long cut from a 12-in. x 6-in. x 44 lbs. R.S.J. Each tee piece was welded to opposite webbs of the pile in counter position and the whole portion concreted up—using rapid hardening cement (Fig. 5). On driving, a set of 85 blows/ft. was achieved at a penetration of 30-ft. when failure occurred once more.

At a cost of providing a complete pyramoidal toe in steel and fitting it to each pile would prove too great, the idea of successfully sealing the open ended piles economically was abandoned. All the boxes piles (52 No.) were driven to set as previously

described above. The average length of pile required was 59-ft. 10-in. A piling record was taken of all box piles (Fig. 6), and a quake record for some (Fig. 7).

Shuttering of the longitudinal and transverse beams followed behind piling. When the inner row of piles in Wharf No. 1 was driven, the piling rig (Menck 27) moved on to drive the inner row in Wharf No. 2. In the meantime, concreting of the beam, over the first row of piles driven, proceeded. As rapid hardening

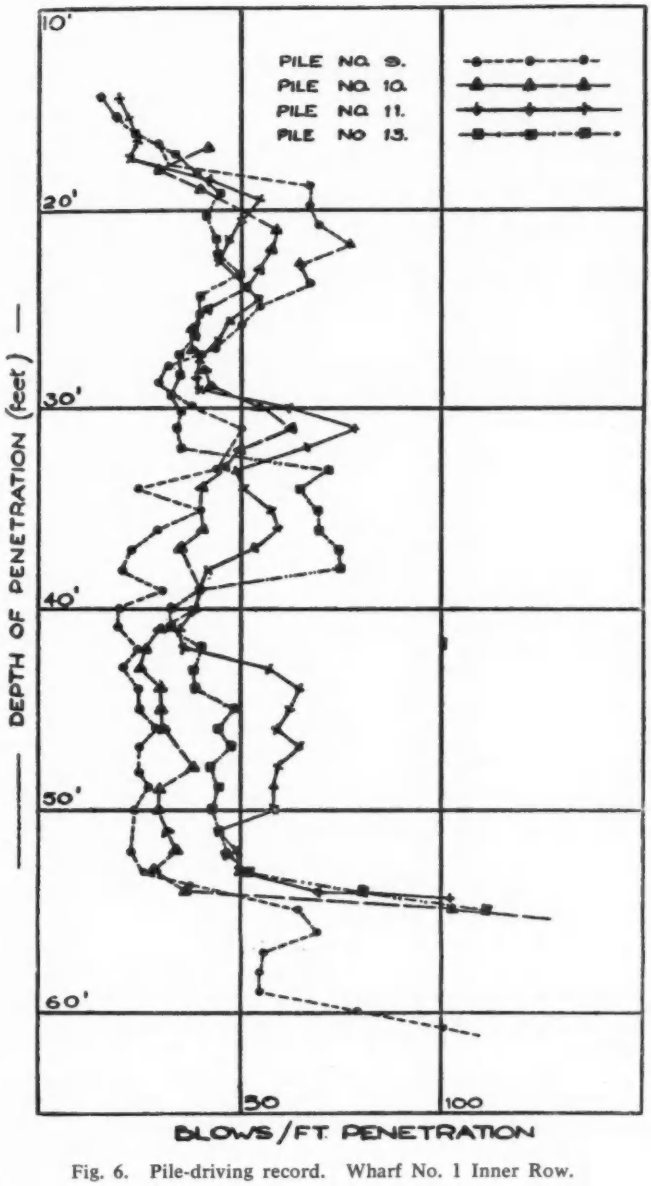



Fig. 6. Pile-driving record. Wharf No. 1 Inner Row.

Portland cement concrete was used a minimum period of seven days elapsed before the contractor was permitted to use a beam to support his rig for next stage of piling. This period was reduced to two days where superimposed loads were those only of pre-cast decking units. When the first row of piles was driven for Wharf No. 2, the piling rig returned and drove the second row of box piles and the fender piles of Wharf No. 1. The rig was supported on the quay wall and the concrete beam to the first row of box piles while doing so. The procedure was repeated when completing Wharf No. 2.

**Pile Splices**

Before pitching the extension pieces, which were frequently 40-ft. long, the top or damaged portion of the partially driven pile was trimmed square. The extension piece was then placed in position by the piling rig and held until butt welding of the profile was completed.

External cover plates consisting of 2 No. 15-in. x 6-in. x ½-in. plates and 4 No. 15-in. x 3-in. x ½-in. plates were then fillet welded in position across the joint and the whole painted with a heavy coat of hot bitumen enamel paint.

In some cases two splices were necessary to complete the driven pile; here, however, the second splice occurred between L.W.O.S.T. and the underside of the deck—the pile already having attained set. Cover plates were not used in splice joints formed after driving had been completed—the welded butt joint was treated with bitumen enamel paint as before.

**Driving Sheet Piles**

While work was in progress on the northside, a Gottwald machine was employed on the south to assist in driving sheet piling down-stream of the dock entrance. Here driving proved

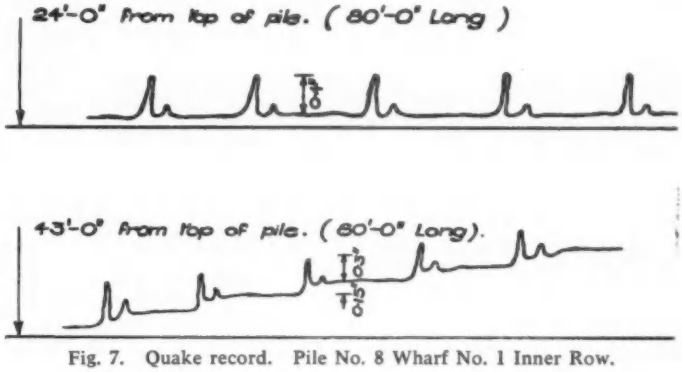



Fig. 7. Quake record. Pile No. 8 Wharf No. 1 Inner Row.

to be more difficult than had been expected from the probe tests, as many obstructions in the form of submerged boulders and stones were encountered. A No. 9B3 McKiernan-Terry hammer was first used, suspended from the rib of the Gottwald, but piling progress by this means was so slow that the contractor decided to try a 7-ton S.A. hammer operating between leaders. In addition, water jetting was adopted using a pressure of 80 lbs./sq. in. and a delivery of about 2,000 galls./hr. Progress was slow as it was difficult to get the jet pipe (which was 30-ft. long) to work its way through the coarse under-layer to ease penetration for the piles. In view of this the contractor was instructed to provide a very much more powerful jet pump which, it was felt, would be capable of displacing the obstructions and allow the piles to penetrate to the depth specified.

While it was feared that the adoption of such a measure might affect the stability of the existing walls, is was decided nevertheless, to use it. In the circumstances, the contractor requested that the conditions of contract, guarding against this very contingency, be waived. The request was acceded to on the undertaking that the piles would be pitched and driven in panels of six or eight, and each panel be given an initial driving before jetting commenced.

A more powerful pump, of the multi stage pattern, capable of delivering 4,000 gallons per hour at a pressure of up to 250 lb./sq. in. was provided. This proved to be the answer to the problem when assisted by a No. 7 McKiernan-Terry steam hammer striking at a rate of 180 blows per minute. The piles went down slowly and erratically, some being more difficult than others.

Remote jetting proved very successful in some cases when dealing with the odd refuser.

The collapse of the old quay wall was consistent with piling progress; actual failure taking place in lengths of about 10-ft. when second stage driving had almost reached final penetration. At no stage did wall collapse precede the second driving stage.

When driving of the sheet piled wall was completed, a continuous horizontal waling consisting of Larssen No. 3 section was strapped and bolted to the top of the piled wall—web outwards. This waling was mainly made up of odd lengths of pile. The system proved very satisfactory in taking up any irregularities in the line of driven piles; the profile of the odd projecting one being incorporated in the flange of the inverted waling by trimming to suit. The space behind the sheet piled wall was then filled with a gravel sand material dredged from the river bed. The filling was brought up to within 12-in. of the top of the piles, a 3-ft. 6-in. berm was then formed and the remainder graded at 1 in 2 to original ground level. The profile thus provided was pitched with 6-in. stone grouted in position with 10 to 1 concrete (Fig. 3).

**Fendering**

To absorb the energy of berthing vessels a flexible system of fendering is provided. It is designed to withstand a horizontal blow from a vessel of 2,000 tons (D.W.) at a velocity of approach of 1-ft. per second.

The maximum intensity of this blow was estimated at 8 tons.

The fendering consists of 12-in. 12-in. greenheart piles driven vertically at 15-ft. centres to provide a clearance of 9-in. with the front of the wharf.

The piles are connected by a 12-in. x 9-in. greenheart waling flush with the back of the piles. The joints between fender pile and waling are heavily cleated top and bottom to assist in distributing the tangential component of a glancing blow on any pile to those adjacent.

Cylindrical rubber buffers 10-in. dia. and 12-in. long are suspended between the concrete beam and fender pile. The top of the pile is fitted with a wrought iron collar to which galvanised chains are fixed, anchoring the pile to the concrete beam. The rubber buffer is also suspended from this collar (Fig. 8).

Three cast iron bollards of 6 ton nominal size are fitted to each wharf, one at the centre and one 15-ft. from each end. The bollards are fixed in position by means of 4 No. 1¼-in. dia. rag bolts concreted into the main fender beam; additional strength is given to the bollard by threading heavy reinforcing bars through the hollow body of the bollards and grouting up.

The main bollard pull is taken directly back to the quay by means of 2¼-in. dia. tie bars 40-ft. long, terminating in anchor blocks. A tie bar pull of 21 tons is provided in addition to the stiffness-resistance of the wharf proper. The cost of each wharf, including the fendering, was £3 18s. per sq. ft. of deck complete.

## Part II—DREDGING CONTRACT

The second part of the scheme provided for dredging 23,500 cu. yds. of sand from the bar, and some 80,000 cu. yds. of coarse material from river bed. The river bed material ranged in texture from mud and sand to coarse gravel and small boulders.

Tenders were invited in the Spring of 1957. Each of the contractors tendering was advised as to the nature and extent of previous dredging operations carried out in the port by State dredgers. They were, in addition, advised on wind (highest frequency and force), tides (rhythm and range), magnitude and direction of coastal currents and surveys of the sea and river bed in the area.

Four contractors submitted tenders for the job on rates which varied from 3s. 6d. to 6s. per cubic yard of material dredged and dumped 1½ miles to sea. The rates did not include for transportation of plant to and from site—the cost of which when distributed over the job, worked out at 1s. 3d. per cu. yd., approximately.

All four contractors showed caution in deciding the plant best suited for the job. As dredging on the bar provided no protection against weather, it was considered imperative that that portion of the work should be done as quickly as possible, thereby favouring suction dredging.

On the other hand, the nature of the material forming the river bed within the harbour together with the age of the quay walls, made the use of a suction dredger undesirable. The conditions of contract made particular reference to the quay walls and provided that damage resulting from dredging operations would be the contractor's liability.

The lowest tender was accepted and the successful contractor decided on the use of a small bucket dredger of the non-propelling

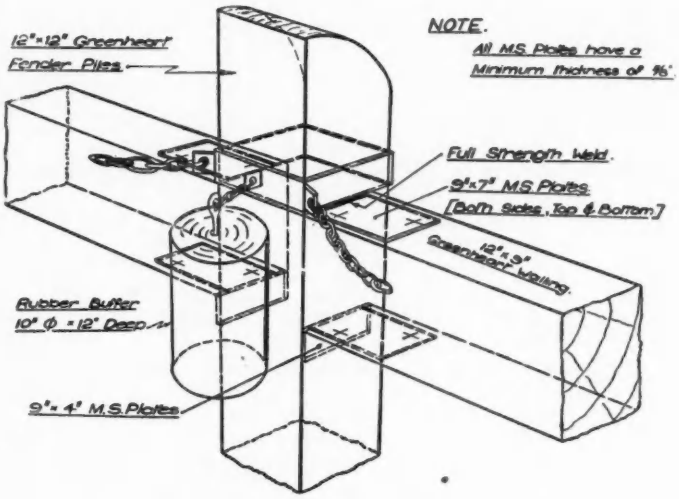

12"×12" Greenheart Fender Piles
NOTE.
All M.S. Plates have a Minimum thickness of ⅜".
Full Strength Weld.
9"×7" M.S. Plates (Both Sides, Top & Bottom)
12"×9" Greenheart Waling.
Rubber Buffer 10" Ø × 12" Deep
9"×4" M.S. Plates

Fig. 8. Detail of Fendering of Wharves.

type for both sections. Two bottom opening hopper barges, each 530 cu. yd. capacity, and a tug were also provided.

Work began on 23rd July, 1957, and was completed on 18th September, 1957. As the weather suited, dredging began on the bar. It comprised cutting a fan-shaped channel through the sand shoal to a dredged depth of 16-ft. L.W.O.S.T. with 1-ft. tolerance for overdredging. The dredging limits were decided upon from information revealed by numerous soundings taken of the area over the previous three years.

Within the pier heads the channel limits were controlled from a consideration of structural safety of pier and quay wall foundations, while at the same time providing the maximum width possible. At no time was the natural slope of river bed material, which protected wall foundations, altered. The maximum value of this slope, which was investigated at a number of points in the river, was found to be 1 in 3.48 horizontal.

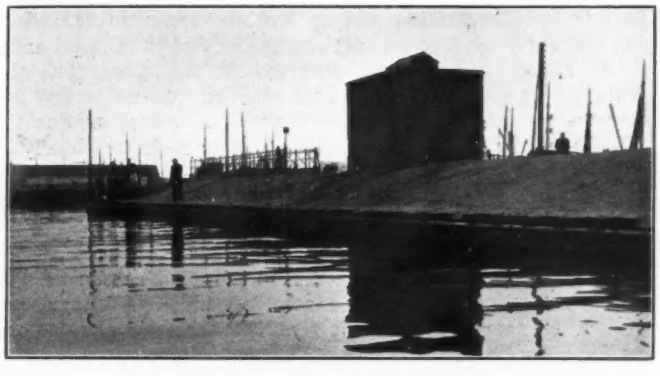
While the extent to which the dredged channel was carried up river was primarily influenced by the maximum navigational requirements of vessels of 1,000-2,000 tons, nevertheless every effort was made within the finance available to extend dredging limits as far as possible. This was desirable in order to provide additional river storage and to increase scour velocity on the bar at ebb tide. For this reason, an additional quantity of material amounting to some 10,534 cu. yds. was dredged from the river bed up stream of the turning basin.

With exception of weather delays and breakdowns in plant,

actual dredging was carried out almost continuously during the course of the contract. The barges were loaded alternately and towed to the dumping ground 1½ miles to sea in a direction 112° east of north. The maximum rate of dredge recorded was 5.12 cu. yds. per minute, the average was 4.61 cu. yds. per minute. The average time taken per round trip to dump was one hour and the average time taken to load was 1¾ hours.

Payment to the contractor was made on a measured work basis with a specified minimum overall quantity.

Typical quay face before strengthening wall.



Completed quay wall up-stream of dock

Material dredged from the bar was paid for on barge measurement while material dredged inside the pier heads was paid for on in-situ measurement. Notwithstanding, all barges filled from both inside and outside the piers were measured before going to sea. Three inspectors were employed on an eight hour shift basis to carry out this work.

Final payment was made on the results of a detailed post-dredging survey carried out on the river and bar immediately the work was completed. The survey was carried out in the presence of the contractor's agent and quantities agreed.

## Conclusion

One of the primary requirements of a harbour is that it should provide adequate depth at all stages of the tide, for normal traffic using the port. The annual cost of maintaining this condition should be a minimum.

Depth may be provided by natural scouring, dredging, or a combination of both. The extent to which dredging is necessary is an index of maintenance costs.

Probably the biggest factor in the maintenance of a port is dredging; yet it is an aspect on which little information is published. Enormous sums of money are spent annually by many port authorities on this work; and the capital cost of dredging plant, its operation and maintenance, is of a magnitude which can be carried only by dredging contractors, large port authorities or State Departments.

The problem, therefore, of development and economic maintenance of a harbour such as that at Arklow is, in essence, no different from others around our coast. The problem is one primarily of accretion, the origin of which can be traced to the influence which marine and harbour works impose upon the local regime of natural phenomena. These phenomena, which comprise in the main, littoral drift, prevailing wind, wave action, ocean and river current, erosion and accretion, all vary in intensity and magnitude depending on location. The effect of a combination of these on topography and artificial works presents a problem of the greatest complexity.

Some harbours have been fortunate in that their location and layout are in accord with the natural regime, while others struggle against it at a high cost of survival.

There is abundant evidence that in the forces of nature order prevails. An analysis of the laws that govern them is therefore necessary before we can design new sea works or improve existing ones with any degree of confidence.

In recent years a considerable amount of research has been carried out in this field through the medium of hydraulic model investigation. The work achieved by J. Allen,[1] F. H. Allen,[2] Gibson[3] and others,[4] indicates that this method is the only satisfactory one for simulating and analysing problems of this nature; consequently the practice of submitting harbour problems to hydraulic research stations for analysis has grown rapidly.

The approach to the problem which continuous maintenance of many of our Irish ports present is one which, in the authors' opinion, requires radial reform. In this respect the provision of a national hydraulic research station is essential.

The implementation of such a practice will inevitably result in increased revenue for capital works by reason of the economics effected.

**Cost of Scheme**

| | | |
|---|---|---|
| Piling Contract | ... ... | £53,870 |
| Dredging Contract | ... | £29,166 |
| | Total | £83,036 |

**Acknowledgments**

The Author is indebted to the Arklow Harbour Commissioners for permission to publish some of the information contained in this paper; and to the Engineering Staff, Marine Section Office of Public Works, for their co-operation.

Messrs. Irish Engineering and Harbour Construction Co. Ltd. were the main Civil Engineering Contractors—whose co-operation throughout the project was much appreciated. In this connection the author's thanks is due to Mr. G. Mekking (director) and Mr. G. Molenaar (engineer agent).

The Westminster Dredging Co. Ltd. were the dredging contractors for the scheme. Mr. Mark Foley was the Clerk of Works.

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# Liverpool Steam Ship Owners' Association Report

## Matters of Interest to Port Authorities

The Annual Report of the Liverpool Steam Ship Owners' Association naturally covers much of the same ground as does the Chamber of Shipping Report referred to in our March issue. It gives a table in summarised form of the figures of the national overseas trading account. This shows in respect of 1959 that a total of £4,008 million was expended on purchases of imports and a total of £3,456 million was realised on the sale of exports, with exports sufficing to pay for 86 per cent of the imports. Taking into account invisible exports arising from shipping and other services rendered to foreign users, it is clear, says the report, that the whole overseas trading account will be in substantial credit balance. The result of the year as a whole can, therefore, be regarded as satisfactory. The increasing incidence of foreign competition in United Kingdom trades is evidenced by the fact that, compared with three years ago, foreign ships engaged in the import trades had increased by nearly 5,000,000 tons of shipping and in the export trades by upwards of 2,500,000 tons.

**Solving a Troublesome Demurrage Problem**

A section of the Report is devoted to railway wagon demurrage. The assessment of liability of shipowners for demurrage on railway wagons consigned to the ports with export merchandise has caused much trouble and dispute for a long time past. A principal source of trouble was insistence on the part of the British Transport Commission to deal with the matter centrally and unwillingness to agree to look at each of the ports concerned in relation to its own conditions and seek local solutions, taking those conditions into account. A welcome change of outlook on the Commission's part occurred after the introduction in 1958 of the Commission's new charging order, following which the Commission accepted the principle of individual port examination.

It was agreed to make a start with the port of Liverpool and to examine a scheme proposed by the Association for assessment of demurrage on a "per ship" instead of a "per wagon" basis. Hitherto, demurrage, representing a charge for detention of wagons beyond a minimum period of time, had been assessed in relation to each wagon consigned to a ship with export cargo, a method which gave no credit for quick turn round of other wagons. The scheme of assessment per ship which the Association proposed was designed to enable delays on individual wagons to be set off against saving of time on others and to provide a fairer way of calculating demurrage by reference to the net result over the whole period of loading of the ship concerned. A "standage scheme" on this basis was produced in draft form as a result of meetings which took place between representatives of the Association, British Railways and the Mersey Docks and Harbour Board and was given an operational trial over a period of four weeks during June, 1959.

Arrangements for participation in this trial were made by the Association with all of its own members concerned and also with other Liverpool organisations, the members of which were concerned with the loading of ships, British and foreign, with traffic consigned by rail. As a result, a total of 117 ships took part in the trial, which proved a success and brought to light very little in the way of administrative difficulty in its operation. Such few difficulties as arose proved readily capable of solution in further discussion between the Association and British Railways, as a result of which it was agreed to bring the scheme into operation on an established basis with effect from June 1st, 1959, the starting date of the trial. Although it is a voluntary scheme in the sense that anyone who prefers can continue to be dealt with on the old basis, it seems that it will become one of general application to Liverpool. It does not apply to Birkenhead or to the coasting trade, to each of which different circumstances are applicable.

The Association is very satisfied with the result of its activities. It hopes and believes that a fair and sensible solution has been found to the troubles and disputes which have for so long caused it concern.

Now that Liverpool has made such arrangements, it is the Association's hope that, through the General Council's Demurrage Committee, equally acceptable arrangements will speedily be concluded in other ports. Discussions are taking place in London, Glasgow, Hull, Immingham and Grimsby and it is hoped will come to fruition in the near future.

**Radio Telephone Services**

The report also refers to the development of V.H.F. (Very High Frequency) radio-telephone services by port authorities, based on the international plan of the Hague, 1957, and the rapid increase in the number of ships fitted with V.H.F. equipment. The Thames Navigation Service was inaugurated in May, 1959, and the established Liverpool Information Service began in November, 1959, to use the new frequencies required by the international plan. Milford Haven Conservancy Board has a detailed scheme for port V.H.F. services under consideration and is already running a small system on an experimental basis, while the Medway Conservancy Board is planning a similar scheme.

Public correspondence services on V.H.F. are being expanded. The G.P.O. coast stations at the Clyde, North Foreland, Niton, Humber and Lands End already have a service in operation. Eventually it is anticipated that the majority of the coastal areas of the British Isles will be covered. At the same time the medium frequency radio-telephone service for public correspondence is being extended to include a special service for passenger ships using frequencies additional to those already in use. The foregoing services will allow for a large increase in radio-telephone communications.

**Passenger Manifests**

On the question of passenger manifests, the Association is at least as outspoken as the Chamber of Shipping. The case of the British Liner Committee, it says, is essentially a simple one and for upwards of a year has not been in dispute. It is that the statutory regulations governing the rendering of information about passengers carried by sea into and out of this country in foreign-going trades involve the passenger lines in an amount of work, in their offices and on board their ships, which is considerable and quite unnecessarily excessive. Further, in their relations with their passengers they are prejudiced and put at a disadvantage because, in the case of air transport, there are no corresponding requirements to constitute a labour to the air carriers and a nuisance to the passengers carried by air.

Insofar as in the past there has been a case for the collection of this information from sea carriers for statistical purposes, the growth of air traffic without collection of information in relation to that traffic has negatived any statistical case that there might previously have been. Even the most optimistic Government statistician would refrain from drawing conclusions in the absence of 50 per cent of the relevant information. It cannot be and indeed is not disputed that there is an unassailable case for relief for the sea carrier and for parity of obligation in this regard as between sea and air carriage. The lamentable fact, comments the report, is that another year passed without action on the part of the Government to put in order a matter which had become increasingly irritating. Discussions with the Ministry were in progress at the time of reporting to bring a modified and simpler system into operation for shipping as an interim measure pending Government decision about air.

# The Operation and Administration of Ports

## Comparison of Various Systems of Management

By B. NAGORSKI.

IN our issue for October last, a brief reference was made to a Seminar on Ports and Shipping Training for the Arab States, which was then being held in Copenhagen under the auspices of the United Nations. Lectures were given on a variety of subjects and, in our January issue, the text of one of these, on "Cargo Handling Formalities" was presented in full. A further interesting paper, "Various Forms of Port Operations" by B. Nagorski was to some extent complementary to another lecture, delivered earlier in the Seminar, on the principles upon which administration of maritime ports is based in different countries.

"The purpose of the present lecture", said Mr. Nagorski by way of introduction, "is to compare various systems of port operations or of the ways in which actual use of port facilities is arranged. It is a subject closely connected with port administration proper but still a distinct one. In two ports having a similar form of general administration, port operations might be organised in entirely different ways. Whether a port is autonomous, municipal or governmental administrated, transit sheds can either be operated direct by the port administration or be rented for a long term to steamship companies or other private operators; physical handling of cargo can be performed either with the labour of the Port Authority as in Piraeus, Manchester or Tripoli in Libya, or by private firms in free competition, as in Rotterdam, Antwerp or New York, or by a single organisation under licence of the port administration as in Latakia."

As can be seen from the following extracts of this lecture, Mr. Nagorski, holds the view that, whereas it is usually more efficient for terminal facilities for bulk and special cargoes to be privately owned and operated, terminals for general cargo might well be publicly owned and administrated but mostly privately operated.

"In some ports", he went on, "there is a tendency to concentrate all port operations in the hands of the Port Administration. The relative Port Authority becomes under this system not only a public body for maintenance, extension and general administration of the port, but also a commercial enterprise performing functions which, in other fields of economic activity, are normally performed by private firms."

The opposite and more normal system is to restrict the functions of the Port Authority in the field of port operations to the role of a supervisor and co-ordinator. Physical work of handling cargo, of towing ships or of handling lines is left to private enterprise, under an overall control of the Port Administration which is ultimately responsible for the efficient functioning of the port.

Both systems have their merits and disadvantages and often a particular system has been developed in a port for purely local or historical reasons, rather than by a deliberate choice of the Port Administration. It would be difficult to formulate a definite set of rules and recommendations applying to all ports, irrespective of long-established practices and specific local circumstances. But it is quite possible to analyse the relative advantages and disadvantages and to indicate broadly which form—public or private—should preferably be chosen for each type of port operations, in cases where a free choice can be made by the Port Administration.

Two main problems arise when dealing with operations directly connected with loading and unloading cargo, which are by far the most important. The first is the form of operating port terminals, wharves, cranes and transit sheds, whether as public or as private facilities. The second is the problem of to whom the physical handling of cargo should be entrusted. The aspects of each problem are different for general cargo with a great number of shippers and receivers, and for bulk cargo such as oils and mineral oils, where trade is generally concentrated in the hands of a few large private companies.

### Operation of Port Terminals

#### Terminals for General Cargo

In a great majority of ports it seems preferable that facilities for general cargo be operated by the port administration so that each berth can be allocated to any vessel arriving in the port according to the best judgment of the port management. In small and medium sized ports, where the number of berths for general cargo is limited, it would be quite impractical to rent a berth to one particular steamship line for its exclusive use. Better use of the available length of quays and of storage space on land can be made if port management has a free hand in assigning to vessels any berth that may be free on a particular day.

In large ports, some regular steamship lines might reach such a frequency of calls that in practice they need one or two berths all the time. It is of course very convenient for a regular line and for its clients if vessels of the line always dock at the same berth. Assembly of export cargo for a given destination is made much easier and the delivery formalities of imported cargo can be better organised by the Line. Very often a steady berth for a regular line can be provided by the port management by assigning from day to day the same place for vessels of the Line, without any guarantee or formal agreement.

However, in many large ports it is the practice to rent certain facilities to private steamship companies on a long-term basis. In Hamburg, for instance, where most berths for general cargo are operated by the Port Administration, exception has always been made for the largest German Steamship Companies, such as Hamburg America Lines or Norddeutsher Lloyd. Certain sections of public wharves have been rented to these steamship lines and often facilities on land, such as transit sheds and cranes have been built by the lines for their own use.

In some other ports this system has been applied on a still wider scale, so that most port facilities are either privately owned or rented to private organisations for long periods of time. This is the case in Rotterdam, one of the largest ports in Europe and in the world, where very few facilities are operated by the municipal port administration. An undesirable consequence is that the port of Rotterdam is short of funds for port improvement as income from rents is not sufficient to meet all financial requirements.

Another example of a very large port where most facilities are privately operated, is the port of New York. Many parts of the port are privately owned and have been developed by the efforts of private individuals or corporations. A great proportion of piers are owned by the city of New York or by smaller towns in New Jersey, like Hoboken or Newark. It is an accepted policy of the relative municipalities to rent city-owned piers either to steamship companies or to other "terminal operators" such as, e.g. stevedoring firms. The company which is renting the pier must cover costs of maintenance and even of dredging alongside the pier. In addition it has to pay to the city a yearly rent of several hundred thousand dollars per pier. To

cover the costs, the tenant of the pier is entitled to charge each vessel berthed alongside a daily wharfage rate for the use of the pier, ranging from about $150 to $500 per ship and per day. The pier operators usually perform all handling of cargo on the pier and on the vessel and apply a part of the profit to offset such costs of maintenance and rent which cannot be met by revenue from wharfage.

Due to an extremely high number of available piers, the port of New York can afford a much lower degree of utilisation of individual berths than is the case in an average European port. In fact, many New York piers are idle for a considerable part of the time as they are used only by the clients of the particular pier operator. The system of public facilities, prevailing in most ports in Europe and the Middle East, is much more efficient. It allows the best possible use to be made of port installations, and financial investments on new deep water wharves to be limited to the actual requirements of an increasing traffic.

**Terminals for Bulk Cargoes**

As already mentioned, the situation is very different with respect to bulk cargoes and specialised trades. From the point of view of convenience of port users, there is no great advantage in having for instance a big oil terminal operated as a public facility by the port administration if practically the terminal is used only by a single oil company. It appears quite reasonable to allow that company to build all installations on shore in accordance with its own requirements and to use them for loading, discharging and storage of various kinds of oil and for subsequent distribution to clients.

A similar situation might arise for some mineral ores, fertilizers and coal. Whenever all bulk cargo on a particular terminal is controlled by a single company, the terminal can with advantage be operated by that company—but if there are several shippers or receivers, as often happens, for instance, on a coal-discharging wharf, it is preferable to have publicly operated facilities, as for general cargo.

**Physical Handling of Cargo**

A very important problem in each port is how best to organise the physical handling of cargo, that is, the work in ships' holds, discharging from ship to shore, moving goods from the wharf to storage space, stacking for temporary storage and delivering from storage to trucks or railway cars, or vice-versa. The entire success of a port may depend on the speed and efficiency of these operations. Training of labour, introduction of improved handling methods and selection of modern mechanical equipment are serious responsibilities, not only of the particular organisation, public or private, which is in charge of cargo handling, but also of the port as a whole. It is a basic duty of the port administration to see to it that handling of cargo is organised in a proper way.

The two extreme forms are either to leave everything in private hands, including mechanical equipment and labour problems, as in New York, or to have all cargo operations performed by the port administration as in the Central Port of Piraeus or within the Free Port of Copenhagen. Between these two extremes there is a wide range of intermediate solutions. In a great number of ports, mechanical equipment, especially shore cranes, is provided and operated by the port, while moving of cargo is performed by private organisations. In some ports, private firms discharge cargo from vessels or load it onto vessels, but the port administration uses its own labour for handling cargo inside transit sheds. In England and in some countries of the British Commonwealth, the supply of port labour is concentrated in a nation wide government-sponsored organisation, the National Dock Labour Board. But cargo handling is still performed in most cases by private stevedoring contractors to whom labour is allocated by the Board.

The choice of the most advisable form of organisation of cargo handling depends in the first instance on the character of a particular berth. For terminals which are used exclusively by one single company, for instance a steamship line, and which are rented to the company, it is logical to leave to that company full freedom to arrange for cargo handling by their own workmen or by a contractor of their own choice. The same applies to restricted terminals for specialised trade, like oil or mineral ores.

But in an average port, a predominant part of the water front is occupied by public facilities for loading or unloading general cargo from any vessel to which a berth has been allocated by the port administration. The question might arise whether on these publicly operated wharves for general cargo, the physical handling of cargo would better be performed by the port administration with its own labour or by private contractors.

The first system has the advantage of a centralised single control over all phases of port operation. It allows perhaps for better co-ordination of ship movements, discharging and loading, unrestricted use of available equipment and storage space, etc. It has the advantage of eliminating the incentive of competition. It creates a kind of monopoly for the port administration which, in addition to performing the work, is acting as its own supervisor. In its quality of sole contractor for discharging and loading cargo, the port administration might be inclined to improve its revenue from cargo handling by higher rates, rather than by all possible efforts for increasing productivity and developing better working methods. At the same time the port administration, as a public trust for the development and promotion of the port, has a duty to see that costs of cargo handling be kept on as moderate a level as possible, consistent with efficiency and speed of work. These two aspects of the interests of the port administration which is acting as the sole cargo handling contractor, might easily be contradictory.

Another weak point of the system is inherent in the very character of port administration. In almost all ports of the world any port authority is a public body, subjected in various degrees to the unavoidable restrictions and inconveniences resulting from bureaucratic forms of public administration, as opposed to the flexibility and relative freedom of private organisations. While the main concern of a manager of a private firm is to perform the work in the most efficient and economic way, his counterpart in a public body is often obliged to watch first whether or not his decision will be in accordance with existing regulations. Public administration proper can and probably must be exercised "according to regulations" but not a purely commercial activity of such a diversified nature as discharging and loading various kinds of vessels and of cargo.

Moreover a certain disadvantage of a port administration acting as contractor for physical work, is the possibility of political pressures in selecting labour and personnel and a restricted margin of freedom in fixing salaries of capable and efficient employees. A private firm has considerable latitude for compensating its personnel in accordance with the actual value of services rendered, while in a public administration it is very difficult to overcome the limitations imposed by fixed schedules of salary steps and grades.

On the other hand, the system of entrusting cargo handling or other port operations to private organisations might also have its disadvantages and dangers. Critics of this system often contend that it is not reasonable for a port administration to let private firms reap the main financial benefits from the port, while funds for port construction and maintenance are provided from public sources and the chief efforts to attract and promote the port are generally made by the port authority rather than by private firms. Some writers have even gone so far as to call private contractors for port operations "parasites", living at the expense of public funds invested in the port.

This seems to be a somewhat academic objection as every public investment whether a port, a railway or a road, is creating earning opportunities for private individuals and organisations. It is the very purpose of such investments to provide new jobs and to stimulate general economic development. A port is no exception to this rule.

The real danger is that private contractors might abuse their almost monopolistic situation and impose on port commerce excessive charges for their services; or, again, that they might become complacent in their efforts to serve clients with due efficiency and speed. This danger may be higher if there is in the port only one firm permitted to perform such vital functions as loading and unloading vessels.

It is necessary therefore for the port administration to supervise rather carefully private contractors in the field of main port operations and to regulate to some extent their activities. One of the means for this purpose is to establish a system of licences for work in the port area and to grant licences only to firms of proved ability. A second measure of control is a system of approved tariffs for various port operations performed by private firms. Tariff rates should be fixed in agreement with the contractors and in consultation with interested port users. They should then be officially approved by the port administration or maybe by some supervising government department, and published as a set of maximum rates which the relative contractors are not permitted to exceed.

By the above measures, port users should be effectively protected against arbitrary overcharges and also against unsatisfactory services, as licences can be revoked in the case of inefficient contractors. In fixing rates, port administrations should not be guided exclusively by the natural desire of port clients for low rates, but also by the necessity for the contractor of working with a reasonable margin of profit which will allow him to renew his equipment and to improve services. Low rates are of little value to ships and cargo receivers, if work is slow and inefficient.

A private stevedoring contractor is obliged to invest substantial funds in his organisation and he must take the risks connected with fluctuations of port traffic. General expenses and amortisation of equipment must be met, even if temporarily there is no traffic in the port at all. It is only fair therefore, that in times of high traffic, contractors should work with a reasonable profit.

It appears clear from the above considerations that in general it is preferable to entrust to private firms the physical work within the port and to restrict the role of a port authority to administration, to port development and promotion, to supervision and the general organisation of port operations. However, there might be cases where the establishment of a public organisation for cargo handling is justified by local circumstances.

It would be wrong to be dogmatic and to rule out in advance a certain system irrespective of specific conditions that might exist in a particular port. The paramount purpose is to have efficient and economic port operations. If this purpose cannot be obtained by employing private contractors, it is only natural for the port administration to take over the job itself. That is what happened for instance in Piraeus, where unco-ordinated work by an excessive number of private contractors led to chaotic conditions and where the port authority succeeded in forming a reliable labour force and establishing a reasonably efficient organisation of its own for loading and unloading vessels. In Libya, a lack of sufficiently qualified local firms seems to have been the reason for the taking over of cargo handling in Tripoli by the port administration, apparently to the full satisfaction of port users.

Two of the many points which Mr. Nagorski made will obtain the particular approval of those who prefer ports to be publicly owned and at least partly publicly operated. As he implied, the more duties the port management accepts, the greater its opportunity to accrue funds to provide efficient, up-to-date facilities. If monopoly were to lead to abitrary overcharges, the port would lose business to its competitors. This applies, of course, whether facilities are publicly or privately operated.

The second point is the essential need, in a busy general port, for the management to control the allocation of berths. If convenient, some berths can then be allocated to specific shipping companies but with the proviso in each case that, when the berth is not required for the regular traffic, it can be used by vessels of other lines.

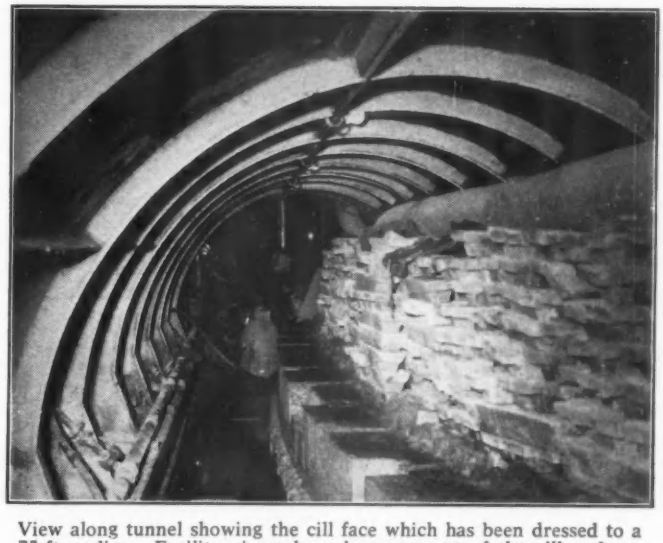
# Renewal of Gates at Sharpness Docks

## Repair Work by Limpet Dam

By R. B. DAVENPORT, B.Sc., A.M.I.C.E.
(Assistant Engineer (South Western Division) B.T.C.)

The Port of Sharpness is situated on the South bank of the River Severn Estuary between Avonmouth and Gloucester, and connects to the Port of Gloucester by the 16-mile length of the Gloucester and Sharpness Canal. Sharpness is a tidal port which will take craft of approximately 8,000 tons deadweight. The craft have to lock up from the river into the docks which extend into the Gloucester and Sharpness Canal without further lockages, giving access to Gloucester for ships of about 700 tons deadweight. There are three sets of gates, two pairs being practically identical with a depth of 36-ft. situated at the tidal entrance and the bottom of the lock. The top gates are 24-ft. deep.

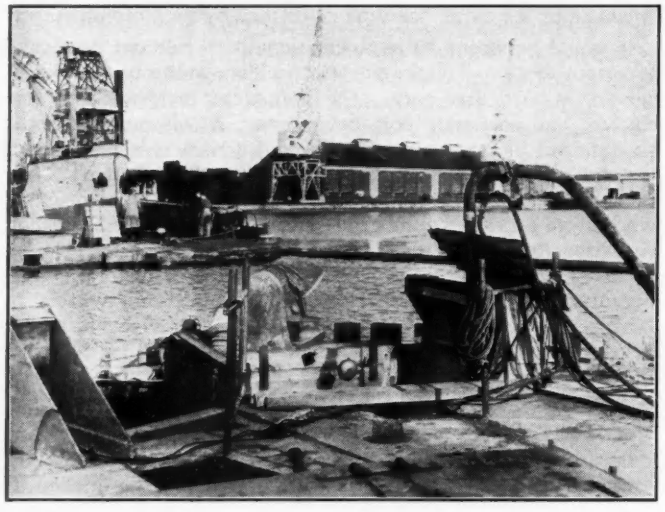
The dock entrance concerned was constructed in 1872 and through the intervening years the masonry supporting the top cill has been damaged both by physical contact and by the water under the masonry. Over recent years the supporting masonry has been extended downstream by building concrete bag work off the lock invert in order to supply a greater mass. In addition



View along tunnel showing the cill face which has been dressed to a 75-ft. radius. Facility pieces have been cut out of the cill and are awaiting filling with granite aggregate concrete. Also visible: the submersible electric pump, the weight stacked on cill to counteract water upthrust; and the large ventilation air main running along the top of the weight providing fresh air and driving foul and dusty air up the vertical section.

the very serious leakages of water under the cill were checked by low pressure grouting. The hollow quoins and cill are of granite and while the quoins appeared to be reasonably water tight, there was a very large leakage along the cill. While the lock gates were being replaced it was decided to make good any deficiency in the cill.

Several years ago the Regents Canal Lock cill and quoins needed renewing and the Divisional Engineer in the South



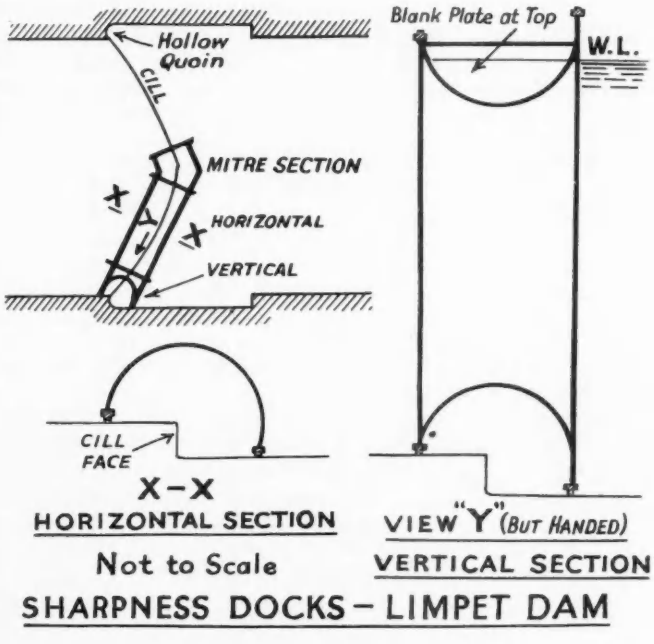
Top of vertical section of the limpet showing its curved shape enabling it to be used at the bottom end at the other side of the lock.

View from bottom of vertical section of limpet dam showing one of the lock's hollow quoins in the centre. The galvanised iron air main for the compressed air tools, pump discharge pipe, electric and telephone wires and power cable to submersible electric pump can be seen on the left.

Eastern Division of the Waterways designed and constructed a Limpet Dam which fitted down the cill quoin, turned at right angles and ran along the cill to the mitre, thereby enabling repairs to be carried out in the dry but without interruption to traffic. At Sharpness it was decided to use the same technique and with minor modifications the same equipment was used.

The dam consists basically of an 8-ft. diameter semi-cylinder with suitable packings along the longitudinal edges and with flanges connecting the three sections of the dam. The Limpet design is rather ingenious, involving a vertical section with a horizontal connection at each end of it, which can be reversed for use on opposite sides of the dock, a straight horizontal section, and a mitre piece fitted with a blanking bulkhead. The horizontal and mitre pieces are removed from the lock bottom, the horizontal section and the blanking bulkhead are removed from the mitre piece, are reversed and placed on the opposite ends of the mitre piece and are then lowered into their new position (see accompanying drawing).

Because of fairly considerable irregularities (of up to 4-in.) in the vertical faces and because of a very irregular bottom, it was not considered adequate to use a conventional rubber sealing strip in conjunction with oakum packing, as there was a great risk of severe torsional effects being caused in the limpet skin. Consequently, at Sharpness the dam was lowered into place and bolted up by divers with the weight supported on jacks permanently attached to the limpet, and the horizontal and vertical




faces were sealed by using a Colgrout Mix retained in a flexible canvas shuttering. Sponge rubber was used to take up the smaller irregularities and the amount of leakage was very small. These techniques were developed by the Civil Engineering sub-contractors.

After the first side had been pumped out it was discovered that the cill stones had become stepped to a depth of about 1-in., but the stones themselves were reasonably sound. Consequently, repair work consisted basically of increasing the radius of the cill from its original 70-ft. to 75-ft.

To guard against the unbalanced water uplift and as a precautionary measure, a quantity of ballast was placed on top of the cill while the masons were at work on the stones. The first side has now been completed and the second half is nearing completion.

The work has been carried out under the direction of the Waterways South Western Divisional Engineer, Mr. F. G. B. Clayton, B.Sc., M.I.C.E. The main contractors for the renewal of the gates and the cill repairs are Charles Hill and Co., of Bristol with the civil engineering being sub-contracted by Nott, Brodie and Co., also of Bristol.

# New Port at Miami, Florida

## Complete Removal of Existing Facilities

The City of Miami, Florida, U.S.A., is to transform its present seaport area into a centre for waterfront office buildings and apartments and to construct a new port on Biscayne Bay, half a mile to the east of the present site, and in front of Miami Beach.

The present port, consisting of three finger piers, was partly constructed in 1912 and Pier Three together with several warehouses and cold storage plant was added in 1935. The port was originally constructed to accommodate coastal shipping and before the Second World War only 17 per cent of the port's trade was overseas. Today the picture is reversed and only 20 per cent of the traffic is domestic. In the past five years the port facilities have become inadequate although port business has generally increased. Figures for 1956/57 show 1,686 ships handled at the port, and for 1957/58 a total of 1,742. Miami has concentrated on dry general cargo and the tourist trade, leaving practically all the bulk handling of the area to Port Everglades, 23 miles to the north.

The present site of Miami Port not only lacks enough room to carry out efficient handling but also lacks space for the necessary expansion. Until recently, however, there was no industry other than tourism and therefore little pressure for marine port development. The bottom of the Florida peninsula consists of a meagre strip of land along the Atlantic coast and acres of everglades and unpopulated swamp in the interior. Nevertheless, over 2,500 industrial firms have been established in South Florida in the last decade and at the same time the area has become a major market for retail goods.

### Design of the New Port

The City of Miami asked their consulting engineers, Ewin Engineering Corporation of Washington, to design a new port to handle dry general cargo which would also satisfy the following requirements: (1) situated close to the centre of the city commerce, (2) functional beauty, (3) operating cleanliness, (4) easy accessibility.

Previous dredging of the ship channel had created several spoil islands along the south side of the channel. After careful study of all the possible sites, the engineers chose these islands (Dodge Islands) as the site of the new port, planning to fill in an area of 200 acres. This port area would connect with the mainland by a rail and vehicular trestle causeway. At the point where the causeway will cross the Intracoastal Waterway which runs north and south through Biscayne Bay, the engineers have designed movable span bridges for both rail and vehicular traffic.

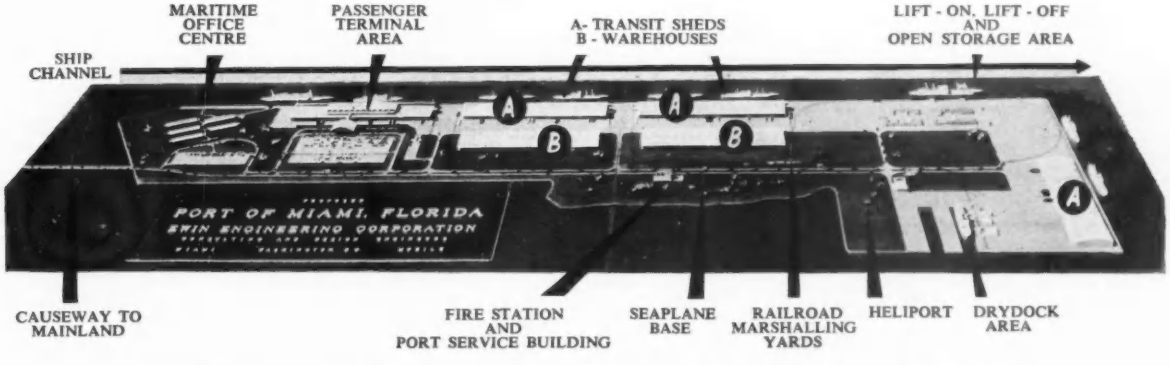
In addition to enlarging the ship channel, federal dredging would be required to provide a deeper and wider approach channel from the Atlantic Ocean; a new turning basin closer to the open sea and a larger turning basin near the Miami mainland.

The City of Miami proposes to finance its part of the relocation of the harbour by clearing the present harbour terminal of all port facilities, filling in the three docks and selling the resulting tract of land to private investors for an estimated $10 million. An additional $3 million would be raised by a port revenue bond issue.

The cost of federal dredging—which is needed in any case—would amount to something less than $4 million. This project was approved by the U.S. Corps of Engineers and the Federal Bureau of the Budget in 1958.

### Layout of the Commercial Port

The consulting engineers have allotted some 40 per cent of the overall 200 acres of the new port area to landscaping. Their plan includes a small irregularly shaped lagoon in front of the five maritime office buildings and the planting of tropical foliage. Wide-laned and tree-lined boulevard streets have been planned with ample access connections. The buildings have been designed to use local materials—Florida stone and coral rock veneer as well as the usual concrete, steel and aluminium. The three transit sheds and two warehouses are to have white, sun-reflecting roofs and the passenger terminal will have a fluted concrete heat-resistant roof with an observation platform for visitors and travellers. The entrance to the terminal is a concrete arch structure which contains lifts and escalators to convey passengers and baggage from ground level to service areas on the second floor. (The first floor of the terminal forms a fourth transit shed.)




Model of the proposed new Miami Island Port with identifications of important areas and buildings.

The plan completely eliminates all bunkering and oil facilities at the port. These are to be located on an island closer to the open sea.

The design of the port provides for mooring vessels alongside 6,000-ft. of marginal wharf running east and west along the ship channel, and then 2,000-ft. north and south at the ocean end of the port island. Provision will be made for the collection of waste from berthed ships, and dumping garbage and oil in the waters about the port will be prohibited by law. Also, as the commercial port will be handling only dry general cargo, a high level of cleanliness should be maintained without difficulty.

The port will be divided into three main operating areas. Area 1 will contain modern cargo-handling and port service facilities; area 2 the five administration office buildings; and area 3 a passenger terminal capable of accepting three 500-passenger cruise ships through Customs simultaneously.

The cargo-handling facilities in area 1 will include three transit sheds and two warehouses with a combined storage space of 1 million sq. ft. Refrigerated storage area totals 275,000-cu. ft. sub-divided into a number of compartments each capable of maintaining temperatures ranging from minus ten degrees to plus thirty degrees, as required. Present facilities for refrigeration have proved adequate but increased cold storage will enable Miami to compete more effectively in shipping perishables to the Caribbean and Central American ports.

Total open storage space at the port will amount to some 80 acres.

The transit sheds will be constructed of concrete block with rigid steel frame roofs and wide cantilever overhang on the sides to give protection against the frequent summer rains. The dimensions of each shed will be 200-ft. by 1,000-ft., and the roof design eliminates the need for internal supports thus permitting the maximum use of the interior of the shed for manoeuvring handling equipment and stacking goods. Vertical clearance inside the shed is 26-ft. at face of walls and 42-ft. at the centre span.

Aprons 50-ft. in width extend from the edge of the wharf to the face of the sheds. The berths are to be constructed to a 7.5-ft. elevation above mean sea level, with the aprons sloping upwards an additional half foot to the sheds. The shed floors will incline upwards another 2-ft. to loading platforms 10-ft. above sea level but actually 4-ft. above ground level, which is the recommended average height for accommodating most heavy transport lorries.

Space between the transit sheds and the warehouses is 200-ft., allowing adequate manoeuvring space for loading lorries to turn round and still providing space in the centre areas for open storage if needed. Parking space will be allocated to accommodate more than 300 large tractor-trailer lorries.

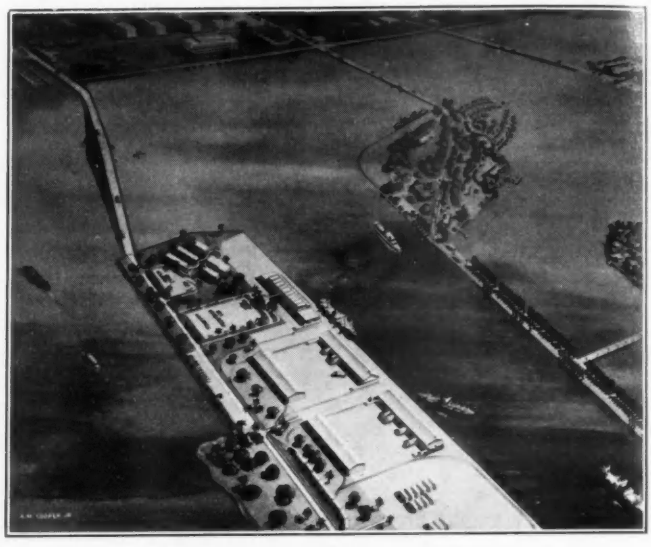
The present Port of Miami showing Biscayne Bay, top left. The Biscayne Boulevard runs along the curved right-hand side of the outlined port. All this is to be filled in, and the white line along upper edge of the port area indicates where the 2,000-ft. causeway will join the new port to the mainland

The ground level rises a foot from the transit sheds to the warehouses and the loading platforms for the warehouses are again 4-ft. in height. These are used only for motor transport and delivery whereas the platforms on the landside of the warehouses are for loading railway trucks which run on a spur track alongside the warehouses.

Lorries may enter the warehouses and transit sheds via twin ramps at the centre of the inshore sides of the transit sheds and facing sides of the warehouses. The ramp doors have a 20-ft. clearance and the door clearances of the dock side of the sheds are uniformly 14-ft.

The rail connections to the transit sheds are at the shed ends only, thus keeping rail and road traffic completely separated at all times.

The port plan envisages full handling facilities for all the modern methods of sea transportation including lift-on lift-off, roll-on roll-off and containerisation. Trailer ships are already



Artist's drawing showing causeway access.

using the present port of Miami at the rate of about one a week and they can be expected to increase their use of the port when it is relocated on Dodge Islands. In addition most of the major transport companies already based at Miami can be reasonably expected to make increased use of the modern facilities when completed.

**Ancillary Facilities**

Area 1 will also include a section for dry dock slipways and other facilities capable of handling vessels up to 15,000-tons. Other supplementary services will include a fire station, port service building, heliport and seaplane base.

Area 2 provides within its five two-storied administration buildings ample office space for port officials, shipping lines, chandlers, importers and exporters, stevedoring companies and forwarding agents. All the offices will be air-conditioned.

**The Passenger Terminal**

Careful detailed research and consultation with port officials was carried out by the consulting engineers when designing the passenger terminal, in order to eliminate as far as possible the time taken to clear passengers and their luggage through Customs.

Baggage will arrive at the checking counters on conveyors and the Customs inspectors will control the flow of baggage by operation of a treadle. More efficient methods of marking baggage have been suggested by which numbers or letters on the baggage would correspond to cabin numbers or deck letters. Thus passengers travelling together in the same part of the ship, even though their names happen to be different, would be cleared through Customs together. Present steamship baggage identification is usually by the first letter of a passenger's surname.

The combination of smoother, swifter baggage flow and more efficient identification is expected to shorten by a third the

*(continued at foot of following page)*

# Safety of Nuclear-Powered Merchant Ships

## Report of United Kingdom Committee

Much intensive research and development work is proceeding both within the United Kingdom and abroad, where the Russian nuclear icebreaker *Lenin* has recently begun carrying out sea trials and the United States nuclear passenger/cargo ship *Savannah* will be at sea in the near future and may be expected to visit the United Kingdom during 1960 or early in 1961. It is important, therefore, that the United Kingdom Government should define its nuclear ship safety policy and requirements without delay in preparation for the reception of foreign registered nuclear ships and the construction and operation of United Kingdom nuclear ships. Further, the international nature of shipping and the possibly widespread effects of reactor accidents make it essential that all governments should prepare and enforce agreed international codes governing the design, construction and operation of nuclear ships.

In March 1958 the Minister of Transport appointed a Committee to advise on the safety problems arising from the application of nuclear propulsion to merchant ships at sea and in port, and the Report of this Committee was published last February.* It represents the first comprehensive study of the problems of nuclear ship safety to have been published in any country and is intended to be related to an initial period of ten years. The Committee included representatives of the shipping, shipbuilding, marine engineering and port industries, including the seafarers' organisations and trades unions; of marine classification societies; and of the Admiralty, Ministry of Power, Office of the Minister of Transport and the United Kingdom Atomic Energy Authority.

The broad conclusion of the Committee is that nuclear merchant ships can be built and operated within acceptable standards of safety. Their main recommendations are as follows:

(a) nuclear merchant ships should be designed, constructed, surveyed and operated in accordance with certain principles, rules and recommendations;
(b) the crew and certain shore-based personnel should be adequately trained for their special duties;
(c) nuclear ships should not receive privileged treatment in navigation;
(d) nuclear ships should have the right of innocent passage through territorial waters, but entry into ports should be subject to the permission of the Governments and port authorities concerned;
(e) the use of individual United Kingdom ports by nuclear merchant ships should receive careful examination;
(f) plans should be drawn up to deal with any radiation hazards which might arise;
(g) radioactive wastes should be discharged from nuclear ships only in accordance with rules to be laid down.

### Consequences of a Disaster

The main dangers external to the nuclear ship arise from collision, grounding, fire and explosion, which might, or might not, be followed by sinking. A major reactor accident far out at sea could lead to the death of all people closely associated with the accident. In addition vessels within, say, a mile and to leeward of the accident might suffer contamination which could result in dangerous exposures of those on board. The seriousness of the situation if the catastrophe took place near land would largely depend on the direction and strength of the wind at the time. In the range from 100 miles down to 25 miles from land, the effect could be one of ground contamination of some foodstuffs, particularly milk. In this case, appropriate control action could be put in hand to prevent injury to people. The damage would be temporary and of local effect, though the need for appropriate emergency management should not be underestimated. If the catastrophe occurred within 25 miles of land, the spread of fission products could have a direct effect on the people living in the affected area.

If the catastrophe occurred within 10 miles of land the consequences would be much more serious and under the worst circumstances could result in the death or injury of many people. Effective control measures can be evolved to reduce the environmental consequences of even the severest form of accident. For this reason the consequences described above can be regarded as a limiting condition, the effects of which have been described to give the order of magnitude of the worst possible consequences.

In port areas more restrictive conditions apply. Most major ports can provide a large ship berth which is 500 to 600 yards from highly populated areas. The maximum rate of release which could take place at such berths in fair weather without creating a situation under which a reasonable emergency organisation would have great difficulty in protecting people from excessive exposures is about 500 curies of iodine per day. This limiting release of activity indicates the necessity for a containment structure with a very high degree of leak-tightness. It also stresses the need for a specially strengthened hull structure around the reactor installation to give protection against simultaneous breaching of the containment structure and primary circuit by any accident in port areas.

### Operational Requirements

The Report states that a fully detailed Operating Manual for each nuclear ship should be prepared for the information and guidance of the master, chief engineer and operating personnel on their duties in all matters related to the operation of the reactor installation and having an important bearing on the safety of the ship and plant. This manual should be prepared

*Command Paper (Cmnd. 958) H.M. Stationery Office, London, Price 3/6 net.

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## *New Port at Miami*—*continued*

present hour and a half average time required for clearing Customs at Miami.

### Port Connections

A further problem faced by the Ewin Engineering Corporation was the difficulty of increasing accessibility to an island port while at the same time reducing, if possible, the traffic on present highways in and around the port area or, at least, not increasing this traffic.

Miami's traffic problem has been bad for years. All road traffic from the port must feed into or cross Biscayne Boulevard, which is the most heavily travelled road in Miami because it is also United States Highway Number One connecting Maine to Key West. In addition, multiple railway lines cross this same highway in two places. Rail movement is unrestricted and the Boulevard traffic is held up many times each day while switching operations are carried out.

The marshalling yards for the new port have been designed to handle 100 trucks at any one time. This will mean that trains will only have to cross the Biscayne Boulevard once a day, between the hours of two and four in the morning when vehicular traffic is at its lowest. Furthermore, adequate rail connections to the port can be maintained on one set of tracks, thus eliminating the need for all the other tracks that at present cross the Boulevard.

Vehicular traffic to the island port will move into and out of Biscayne Boulevard via a pair of one-way lanes connecting up with the 2,000-ft. causeway.

by the designers of the plant in conjunction with the prospective owners of the ship and it should be subject to the approval in detail of the Ministry of Transport. Its provisions should be kept fully under review by the master and owners, who should advise the Ministry from time to time of any changes they regard as desirable.

In connection with manning requirements and training, the Report recommends that the master and chief officer and, if possible, the other deck officers should have attended an approved course of instruction in the basic principles of nuclear energy, its application to merchant ships and its particular application to the ship in question. The chief engineer should hold an appropriate first-class certificate of competency and have successfully completed a course, probably, of 12-15 months' duration, in the principles of nuclear energy, in radiological health precautions and in the principles and operation of the type of reactor to be under his supervision, and have received a licence to this effect—a "supervising" licence.

During the inital period, the competent authorities should satisfy themselves that the ship and the reactor installation are in a safe condition before a nuclear ship is allowed to enter United Kingdom port waters.

Dealing with the responsibilities of H.M. Government, the committee recommends action should be implemented for: The licensing and inspection of United Kingdom nuclear ships; assessing the safety of nuclear ships registered in other countries; the control of the use by nuclear ships of individual United Kingdom ports; of the training of officers of nuclear ships and experts to advise on safety arrangements in ports. The committee also recommends that the Government should implement arrangements for the control of any emergencies which may arise.

**Arrangements in Ports**

The Report emphasises that a programme for training personnel of the port authorities, health authorities and other interests and govermental departments concerned with nuclear ships should be drawn up in good time. It is essential that comprehensive arrangements should be made to deal with possible radioactive hazards from a nuclear ship in port, however remote the risk of their occurrence.

# The Port of Ensenada

## Description of a new port on the Pacific Coast of Mexico

*(Specially Contributed)*

Ensenada a new port for deep sea vessels, was opened recently on the west coast of Lower California, Mexico. It is situated on the northern sweep of All Saints Bay approximately 70 miles from the frontier of the United States of America at lat. 31 52°N., long. 116 38°W. It has an historical background; in 1585 Sir Francis Drake invaded the hinterland from Ensenada to Mexicali and claimed the fertile valleys for England. This land is now being extensively developed and the crops grown there, in particular cotton, will be exported through the new port.

From the point lat. 32 31°N. and 117 07°W., the coast line extends to the south east and follows a continuous line to the cape of San Miguel and the Bay of All Saints. This Bay is an open crescent which terminates in Cape Banda; there is a low sandy foreshore and, to the north west there is a chain of islands lying between the capes of San Miguel and Banda. The channels between the islands are deep; the north west passage between Cape San Miguel and the submerged reef has an average depth of 53 metres and is 7,600 metres wide, the south west passage between Isla Grande and Cape Banda is 4,700 metres wide and 125 metres deep.

**The Port**

Vessels approach the port on a south to north direction in deep water and, once inside the breakwater-head, the port channel to the overseas berths is dredged to 10 metres depth alongside the berths. The mean tide level, port datum, is 1.636 metres and the normal range is 1.20 metres; spring tide range is 2.30 metres.

The prevailing wind is south-south-west and velocity averages 5 metres per second, whereas the predominant storm wind is south and averages 28 metres per second. The sea bed is of sand. The harbour is protected by a tipped rubble breakwater of natural rock 1,200 metres in length, rooted in the rocky bluff of Cape Ensenada to the north of the harbour and aligned NNW-SSE. When finally completed the breakwater will be 2,000 metres in length, the head swinging in towards the shore following the 10.50 metres sea bed contour, the crown width 10 metres except at the head where it will be 30 metres.

**Quayside Berths**

The quay for coastal shipping lies at the root of the breakwater making an angle of 80 degrees with the latter. The wall is widened to 70 metres to form the quay D-E which links this quay with the overseas berths. A concrete wall of trapezoidal form has been constructed in the harbour (see Fig. 1). This is used for berths for the deep sea vessels using the port and plans are in hand to backfill this area, about 200 metres wide by 440 metres long, so giving space for sheds and uncovered storage. Further along the mole, a rubble spur 200

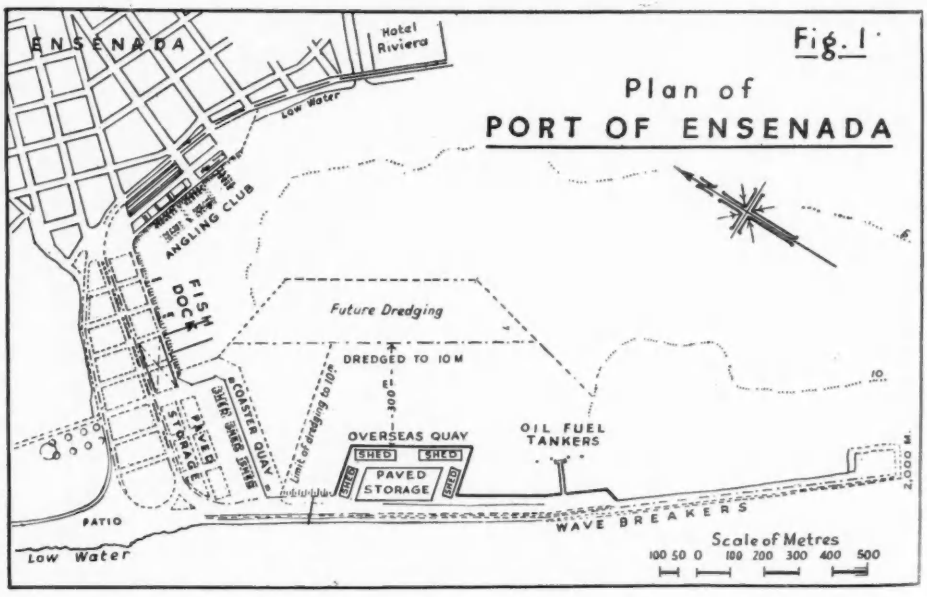

Fig. 2 Showing the overseas berths under construction and in use. Top left, quarry from which stone for breakwaters was obtained. Wave breaker protection and the mole is visible to the left of the wall.

Fig. 3. Showing substantial progress made within a few months. Coasters are now using their own berths and the main quays are being used by ocean-going vessels. The fishing fleet and yachts can be seen in the foreground.

metres in length has been constructed into the harbour and it is intended to improve this in the future to form a berth for tankers bringing oil fuel to the port.

At the present time construction work has been halted on the breakwater and two deep sea berths are in use, one of which is equipped with a single storey shed (No. 5). The berths are 170 metres long with depth alongside of 10 metres, and the deck level of the quay above mean sea level is some 2 metres. The shed is 120 metres long by 30 metres wide, height to eaves and cross ties of roof trusses 6 metres and floor space available 3,630 sq. metres. This is owned by the Mexican Federal Government.

**Coastal Shipping Zone**

The coastal shipping zone of the port lies to the north west and comprises 3 berths, each of which is to be provided with one covered shed, uncovered storage space and hard standing for lorries. The total length of concrete quay wall is 470 metres and the sheds will be 100 metres long by about 30 metres wide. So far, only one of these has been completed.

**Fishing Harbour**

Development of the fishing industry has been encouraged by the Mexican Government and, although there has been little support from local fishermen, it has been decided to provide good port facilities for the industry. To the east of the zone for coastal shipping, berths have been arranged for trawlers and smaller vessels, sheds have been set up for auction sales and the preparation of fish and for storing tackle and gear.

**Economic Future of the Port**

At the present time the port of Ensenada is fairly active in the export of cotton to Europe and Japan and it is hoped that, when the port works are finished, shipments will reach half a million bales a year.

The first test cargo of cotton was exported in November 1957 and actual traffic started in March 1958 although the port works were unfinished. By March 1959 the port had exported no less than 258,955 bales in 150 vessels.

In addition to cotton, some other goods are handled at the port principally for export to Japan. Products from the U.S.A. destined for the East have been re-exported as well as Japanese goods for Arizona.

In spite of the unfinished state of the harbour and its installations, the organisation of services has been good and vessels entering and leaving the port have received efficient handling. In the near future vessels will be able to obtain fresh water, electric power and connections with the telephone system of the town. The supply of oil fuel is also under consideration. Pilotage and towage services are compulsory.

The form of stevedore rates is based on the tons moved and the distance and not on the time taken to do the job. For example, the discharge of cement in sacks is, under normal conditions, 1,000-tons per 8-hr. day, and the loading of cotton in bales by manhandling and vessels own appliances at a rate of 100 bales per hour.

The absence in the project to date of any provision for railway tracks to or in the port appears incongruous in the light of current world practice. This affects the lay-out of the installations and structures, as the present disposition of the sheds, quayside aprons and standings will not easily be adaptable to take rail traffic at a later date. There is no space allotted for marshalling yards, service maintenance of rolling stock or bunkering. Without careful planning in the early stages, the port is unlikely to develop its full potential in the future.

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**British Transport Docks** announce the appointment of Mr. Stanley Johnson, F.C.A., M.Inst.T., as Assistant Chief Docks Manager, Hull. Mr. Johnson has served since 1939 with the Singapore Harbour Board where he filled several senior positions, finally retiring in 1958 as Chairman and General Manager.

# Tonnage Measurement of Ships

## The Case for Simplification of Existing Rules

THE tonnage measurement of ships is one of the technical subjects referred to the Inter-governmental Maritime Consultative Organisation (I.M.C.O.) by its parent body, the United Nations. The sub-committee dealing with it held its first meeting in London in June last year.

Every vessel must have an official size for the purpose of assessing harbour dues, etc. The yardstick for this the "ton" of 100 cubic feet and the process of ascertainment is known as tonnage measurement.

Two important contributions to the consideration of this matter have been provided by Dr. Ing. Luigi Cristiani, a member of the Institution of Naval Architects and by Mr. W. Errington Keville, C.B.E., a deputy chairman of Furness, Withy and Co. Ltd., and chairman of the Tonnage Measurement Committee of the Chamber of Shipping.

Mr. Keville wrote an article for "British Shipping", the official organ of the General Council of British Shipping, and Dr. Cristiani read a paper to the spring meeting of the Institution of Naval Architects.

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In his article Mr. Keville wrote:—

For many years past there has been a persistent movement in favour of simplifying the various rules at present in force throughout the world for the measurement of ships' tonnage and for the adoption, if possible, of a universal system. With I.M.C.O. now operating as a fully active organisation, it is natural and suitable that this body should undertake the responsibility for examining this problem in all its aspects.

The British system of tonnage measurement as we know it today was mainly influenced in the middle of the last century by Mr. George Moorsom, a student in the School of Naval Architecture and later Surveyor-General for Tonnage, who was appointed secretary of a Commission set up to examine the whole question. The new tonnage laws resulting from this investigation were embodied in the Merchant Shipping Act of 1854. These laws, which are based on the principle "that the whole internal space of a ship should be measured in order to establish her capacity" have, subject to comparatively few important amendements, stood the test of over 100 years.

Before proceeding further, let me very briefly examine the origins of the measurement of ships. Clearly the original intention was to arrive at some standard of the size of cargo-carrying capacity of the ship in order that dues might be levied on ship or cargo.

The word "ton" is derived from the old English word "tun" which, in the Middle Ages, was a definite legal standard of measurement. The word "tonnage" appears to have originated when tax was levied on the number of barrels of wine or "tuns" which a vessel was capable of carrying, and in the early 15th century it was decreed that a "tun" of wine for carriage was to measure not less than 252 gallons, or just over 40 cubic feet. It is clear that in the early days the carriage of wine was closely identified with the origins of our present system of tonnage measurement.

In 1694 a system of deadweight measurement was introduced for keels carrying coals in the Tyne and Wear and the wording of the Act read as follows:—

> "The said admeasurement shall be by a deadweight of lead or iron, or otherwise, as shall seem to meet the said Commissioners, allowing three and fifty hundredweight to every chaldron of coals . . . and cause the said keels and boats so admeasured to be marked and nailed on each side of the stem and stern and midships thereof . . . and provided that no such keel or boat shall be admeasured, marked or nailed to carry more than ten such chaldrons at any one time."

Actual weights were placed on board to the limit of 26½ tons, as before described, and the load line was marked by nails in the stem, sternpost and midship planking. These vessels were, therefore, not allowed to load to a deeper draught.

This enactment was eventually extended to all other parts of Great Britain in 1775, but the standard of deadweight became twenty hundredweight avoirdupois to the ton.

### Gradual Realisation of Need for System

The 18th century saw a greater awakening to some acceptable system of tonnage measurement which could be applied to all classes of merchant ships and in 1773, in the reign of George III, the existing regulations were revised and the method then introduced of estimating tonnage came to be known as "Builders Old Measurement". In 1819 the Act of 1773 was extended to meet the introduction of steam navigation and the length of engine room was then allowed as a deduction from the tonnage length.

Commissions of Inquiry into the tonnage laws were appointed in 1821, 1833 and 1849 as a result of which it came to be accepted that "internal capacity" was considered to be the fairest standard of measurement. These Commissions paved the way for the Merchant Shipping Act of 1854 when, under the influence of George Moorsom, new laws were introduced.

As indicated earlier, under the Act of 1854 the measurement of gross tonnage is based on the principle that the whole internal space of a ship shall be measured in order to establish her capacity. The sum of these capacities in cubic feet after division by 100 indicated the gross tonnage. The register, or net, tonnage was obtained by deducting from the gross tonnage an allowance for the space occupied by the propelling power and bunkers. This is an expression of the formulae in the simplest terms possible.

To return to the present, before the last war the League of Nations investigated the question of tonnage measurement and in 1939 produced a draft Code of Rules (International Regulations for Tonnage Measurement of Ships) which closely followed the British Rules. This Code of Rules was recommended for universal adoption. The war intervened, however, before any finality could be reached, but in 1947 a number of European countries convened a meeting in Oslo and adopted the international regulations. These regulations, as amended, came to be known as the Oslo Rules. The Oslo Code which is practically identical to the British Code, does not, however, satisfy the Suez and Panama Canal authorities.

Today, the world tonnage authorities may be grouped as follows:—

**British Rules.** The United Kingdom, the Commonwealth and Colonies. Other countries such as Spain, Portugal, Yugoslavia, Japan and Greece, apply, or closely follow, the British Rules.

**Oslo Rules.** Norway, Sweden, Denmark, Finland, Iceland, the Netherlands, France, West Germany, Israel.

These follow the International Rules as amended by the Oslo Conference. Countries following the British and Oslo Rules represent a combined tonnage of 65 million tons gross.

**American Rules.** U.S.A., Liberia, Panama and certain South American countries. These follow the U.S.A. Rules and represent a combined tonnage of 43.5 million tons gross, including the U.S.A. Reserve Fleet.

**Suez Canal.** The Suez Rules were decided a an International Convention held in Constantinople in 1873 and amended by agreement of the contracting states in 1904. All ships passing through the Canal require certificates showing their tonnage calculated in accordance with the Suez Rules. The Rules are based on the Moorsom system, but are more stringent as to exemptions and deductions than the British Rules. The net Suez tonnage is appreciably higher than the British.

**Panama Canal.** These Rules were drawn up by a Professor Johnson, on instructions from the Government of the U.S.A. They are closer to the Suez Rules than to any other code, being more stringent as to exemptions and less stringent as to deductions than the Suez Rules. The net tonnage under the Panama Rules is higher for most vessels than the British net tonnage, but is appreciably lower on certain types of vessels, e.g. ore carriers.

The differences between the British and Oslo Rules on the one hand, and the American Rules on the other, are mainly confined to the treatment of water ballast spaces and the exemption of passenger spaces in the superstructure.

As the latter can lead to substantial variations in the tonnages under the respective Rules favourable to the Americans, the United Kingdom and certain European countries insist on U.S.A. passenger ships having supplementary certificates showing the extra tonnage under the United Kingdom Rules.

In considering the possibilities of achieving a uniform system of tonnage measurement, very serious regard must be paid to the purposes for which "gross" and "net register" tonnages are used. In the United Kingdom their uses are widespread. To quote only a few examples, under the National Maritime Board Agreements "gross tonnage" is the basis used for determining the scales of pay of navigating, engineer and radio officers and of a substantial number of ratings. Gross tonnage also determines such important matters as the minimum number of certificated navigating officers to be carried and the minimum composition of an engine room watch on foreign-going ships. The Ministry of Transport Rules for construction, life-saving appliances and fire appliances are also based on gross tonnage. Light dues are based on net register tonnage, and so in the main are harbour dues, while pilotage charges vary as between gross and net.

Attention is drawn to these very important factors, for it will be obvious that in considering any entirely new basis for the measurement of tonnage there is a grave risk that many long-standing arrangements affecting not only personnel under National Maritime Board Agreements but also safety and other rules, together with the basis of levying port charges, will be seriously disturbed unless, under any such new agreement for measurement, the resulting tonnages of vessels are approximately the same as under our existing basis.

What are the factors in the present systems of tonnage measurement likely to render difficult the achievement of a uniform system? In my view this how the three principal difficulties relate. Firstly, there is the different treatment accorded to water ballast spaces under the British and Oslo Rules on the one hand and the American Rules on the other. Secondly, it may be contended that the present basis of propelling power allowance should be re-examined. Thirdly, another item which will undoubtedly provoke serious discussion, and in which United Kingdom owners are greatly implicated, is the treatment accorded to the "open shelter deck" type of vessel. As is well known, this type of vessel is greatly favoured in this country, and owners who adopt it will defend it not merely on the score of the substantial savings in dues by reason of the lower gross and net tonnages, but will also argue that this type of vessel provides a well-balanced design capable of meeting variable requirements. There is a tendency nowadays to build ships with sufficient strength in their scantlings to permit of the vessel being converted from the "open" to the "closed" shelter decker as required. Moreover, it is contended that there is no evidence to prove that this type of vessel is undesirable from the safety point of view.

### An Historic Case

The open shelter deck ship owes its development to the historic case of S.S. "Bear" which was decided in the House of Lords in 1875. The case rested on the contention that the "Bear" had an upper or spar deck above the tonnage or main deck and that this should have been measured in accordance with the rules under the Merchant Shipping Act, 1854. It was, however, decided that this deck in question, which was provided with openings extending across the vessel, could not be considered a continuous deck extending from stem to stern and was therefore not a complete deck but a shelter deck affording protection from the weather and that in consequence the space between the upper and main deck could not be considered as a closed-in space on the upper deck available for cargo. It is doubtful whether their lordships in reaching this decision foresaw the far-reaching consequences of their findings!

From this brief summary of the position it will be evident that the task which lies ahead of the Tonnage Measurement Sub-Committee of I.M.C.O. in considering the complicated question of tonnage measurement will be far from easy and will require an open-minded approach to the problem on the part of all countries participating in the discussions. If uniformity can be achieved on an acceptable basis it must be recognised that this would confer benefits on the world's maritime community.

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*Note:* Acknowledgments are made to the late Mr. E. W. Blocksidge's admirable paper on the subject read to Lloyd's Register Staff Association on 21st May, 1924, also to various papers prepared by the Ministry of Transport and Civil Aviation.

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In his paper, Dr. Cristiani discussed the advantages of an international tonnage rule and put forward some proposals to simplify the existing measurement rules. A summary of the Paper reads:—

After the first World War, the League of Nations faced the problem of an international rule for the measurement of ships, but after many international meeings no conclusion was reached.

After the second World War a conference was held in Oslo in 1947 to study modifications to the existing rules, but the number of nations participating in the conference was limited.

It might therefore be said that the following main problems relating to the measurement of vessels have still to be solved internationally:—

**Simplification of the existing Rules.**—The reasons for such a simplification are too well known to all naval architects to make it necessary to repeat them. The first point to be discussed might be the choice of a criterion to identify a sea-going vessel and how best to represent her commercial value; for example, it might be advisable to adopt the displacement or some other dimension instead of the gross or net tonnage. Whatever parameter is selected will have both favourable and unfavourable points; but after examination of the many suggestions the method adopted about a hundred years ago in Great Britain is in the author's opinion, still the best criterion.

**Agreement on a common standard,** as a basis of an International Rule would have the following advantages:—

It would not be necessary to remeasure the vessel, as happens now, when there is a change of flag.

It would be possible to check periodically the actual condition of the vessel with reference to the data of the International Tonnage Certificate, in the same way as is now done for the International Freeboard Certificate.

It would fix a universal standard for the working of International Rules, like the 1948 London Convention, which is generally based on the values of gross tonnage.

It would be possible to abolish the special tonnage certificates, namely, Suez and Panama Canals, the tariffs being modified accordingly.

Although there are some differences between the criteria employed for levelling taxes in the various maritime countries, most of the taxes are referred to gross tonnage. Further, tariffs for pilotage, tugs, mooring and dry-docking, also fees for the surveys held by the classification societies and the maritime authorities, are usually all assessed on this basis.

But the values of gross tonnage are also important for the following reasons:—

The assignment of freeboard is compulsory if the gross tonnage is equal to, or more than, 150 tons.

A ship must be equipped with a radio if the gross tonnage is 1,600 tons or more.

The number of the crew is generally fixed according to the gross tonnage.

According to the 1948 Convention (London), the equipment depends on gross tonnage.

In Italy the port dues and health certificate taxes are based on net tonnage. In Great Britain even the light dues are based on net tonnage, as also are the fees for the passage through some canals—Suez, Panama, etc.

The criterion of gross tonnage appears to be the most important one in connection with the employment of a vessel. Therefore, the measurement of a vessel for identification and commercial purposes might be limited to the gross tonnage, it being feasible to modify accordingly the fees now based on net tonnage. This would certainly mean an important simplification in tonnage calculations.

**Tonnage decks and freeboard deck.**—Generally speaking, the most important maritime countries, in their rules for the measurement of vessels, have the following definitions:—

**The tonnage deck** is the upper continuous deck in all ships which have less than three continuous decks, and the second continuous deck from below in all other ships.

Below the tonnage deck there are no open spaces—that is, spaces fitted with tonnage openings—which are supposed to give insufficient protection for the stowage of cargo from bad weather and the sea.

**Tonnage upper deck** is the uppermost continuous intact deck under which there are no open spaces.

The volume below the tonnage deck is computed by finding the area of a number of vertical sections along the length of the ship and Simpsonizing these areas to give the volume.

The volume between the tonnage deck and each continuous intact deck up to the tonnage upper deck is calculated by the simpler method of multiplying the horizontal area at mid-height by the mean height of the 'tween deck.

**The freeboard deck,** according to the Rule agreed internationally, is the highest deck having all the openings closed by standard means and in way of which the freeboard deckline is marked.

The non-existence of "open spaces" below is a characteristic common to the tonnage deck and to the freeboard deck. It is suggested that the freeboard deck be also considered the tonnage deck, with one exception, that is the case of an "open shelter deck" that has been closed, but with the ship still retaining a limited draught so that the freeboard mark is below the freeboard deck appropriate to the open condition. In such circumstances the tonnage deck shall be the first continuous deck above the freeboard mark.

It is also suggested that the term "upper tonnage deck" be abolished. As a consequence, a vessel for measurement shall be divided into two zones: the zone below the tonnage deck and the zone of superstructure above this deck.

If a vessel has no International Freeboard Certificate the freeboard deck shall be the deck from which the maritime authorities measure a "safety freeboard". Generally speaking, this applies to small vessels with only one deck and restricted navigation.

**A simplified method of calculating the volume under the tonnage deck.**

Let L=length as per freeboard rules;
B=breadth as per freeboard rules;
D=maximum draught to summer freeboard;
W=displacement at the draught D, as from curve of displacement; in metric tons;

$$\phi = \frac{W}{1.025\,L\,B\,D} = \text{block coefficient, the minimum value of this coefficient being 0.65;}$$

H=height from bottom structure of the vessel (top of double bottom; top of floors or longitudinals) to 2/3 of round of beam of the tonnage deck, plus the mean value of aft and forward sheer of same deck.

According to the results of many calculations for various types of vessels, the volume underdeck is:

$$V = \phi\,L\,B\,H$$

Should it not be possible to get a reliable value of the displacement W, the volume under deck may be reckoned by the usual method, the Simpson Rule.

If the height of the bottom structure changes along the length L, the aforesaid method of reckoning the volume V shall be used for the various parts, adding then the partial results. For example, if in way of the midlength of the vessel there is a change of more than one foot in the height of the bottom structure, i.e. D.B. or floors, the length L would be divided in two parts, $L_1$ and $L_2$ and the volume underdeck would be equal to $\phi . B.(L_1 H_1 + L_2 H_2)$; $H_1$ and $H_2$ being the heights corresponding to $L_1$ and $L_2$ measured as described for H.

**Superstructures and measurement of their volume.**—As already suggested, the tonnage deck should be the freeboard deck or the first continuous deck above the freeboard mark in the case of a closed shelter decker. Therefore any erection above the said deck shall be considered a superstructure, as regards tonnage measurement.

It is convenient, for the measurement, to divide the superstructures into two categories:—

Complete superstructures covering the total length of the deck, for which it might be advisable to use the same method now adopted for the 'tween decks (area of the horizontal section at mid-height by the mean height of the superstructure).

Non-complete superstructures or deck erections, for which it is suggested the existing method should be retained, that is volume=mean length×mean breadth×mean height.

When there is a complete superstructure of the first tier, an important case is, in the author's opinion, the "open shelter deck," which is a structure having an opening on its deck, so that this deck cannot be considered the freeboard deck, and also having openings in the transverse bulkheads of the 'tween deck, so that the volume of this 'tween deck is exempted from measurement, if available only for cargo. However, in some cases—according to the Rules of some important maritime countries—any merchandise stowed in these "open spaces" is considered deck cargo and taxed accordingly.

Of course, the "earning capacity" of a cargo vessel depends on the space available for cargo—and has, as an upper limit, the maximum weight of the cargo itself, fixed by the positions of the freeboard mark.

From a safety point of view it would certainly be advantageous to do away with any opening on the deck or within the 'tween deck of an "open shelter deck". To this effect it is suggested that **any space available only for cargo within any superstructures, as defined above, be exempted from tonnage.** As a matter of fact, such spaces are generally used only when the cargo on board has a low specific weight. The same modification of the existing Rules may be suggested for the spaces within non-complete superstructures or deck erections, on the same condition.

On this ground shipbuilders may perhaps be tempted to increase unduly the number and volume of superstructures, but this practice would be limited by conditions of stability in accordance with the 1948 London Convention.

Finally, to sum up regarding the measurement of superstructures, the following exemptions from gross tonnage are suggested:—

Spaces containing boilers and donkey boilers not supplying steam to the propelling machinery.

Air and light spaces to propelling power or auxiliary machinery rooms.

Entrances to underdeck spaces.

W.C., baths, etc., not contained in a separate passenger cabin.

Any space available only for cargo within the superstructure and having no permanent arrangements for passengers.

In a comparison between gross tonnages according to the existing rules and his suggested modifications, Dr. Cristiani said that it appeared these was little difference between the values of gross tonnage regulations according to the Italian rules (which are similar to the British Measurement Rules) and the values of gross tonnage according to the modified rules suggested by the author. The changes were far from being revolutionary and were limited to simplifying some of the rules and bringing them up to date.

# Correspondence

*To The Editor of The Dock & Harbour Authority*

Dear Sir,

**"Surfacing of Wharves and Roads"**

I refer to the article in the February and March editions of "The Dock and Harbour Authority," in which the author refers to the technicalities of providing a durable and economic pavement. Reading through this article I felt that there were a number of points raised which might give a misleading impression, and I should like to comment on these.

Before deciding on the nature of the pavement to be constructed, tests to give the C.B.R. or modulus of subgrade reaction should be carried out, and the thickness of pavement taken from the various curves extant. Care should be taken that if the soil conditions change appreciably during the subsequent seasons or during the construction, then either drainage should be provided at such a level as to nullify the change in soil moisture content as far as possible or the pavement should be designed for the wettest and weakest conditions.

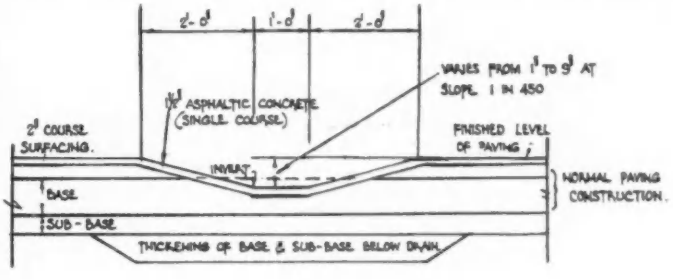
The tables and curves published by such organisations as the D.S.I.R. then enable one to select the thickness of pavement or in the case of concrete roads the thickness of slab, reinforcement if required, spacing of joints and other such factors, the thickness being related to the traffic intensity. If there are no insuperable factors, such as the settlement of the ground on which the pavement is built, then the choice between flexible and rigid pavements is based on cost and availability only.

In the design of paving the author's recommendation on page 336, that the C.B.R. value be measured in-situ on each structural element might give a misleading result if there are more than about 5% to 10% of stones larger than ¾-in. Since the area of the plunger is only 3 sq. in. the test may indicate a much greater bearing capacity than is available should the plunger be driven on to a large stone in the sub-base. When the sub-base material contains more than about 10% of large stones, greater than ¾-in., then it is usually accepted that it will have a C.B.R. value greater than 15% to 20% when compacted, which is the minimum required in a sub-base. It is then not necessary to take any further C.B.R. measurements on the pavement above.

Design based on the use of Westergaards formula, as mentioned by the author, even as modified by Teller and Sutherland or by Pickett does not give results which can be used with confidence, since the appreciable stresses due to factors such as temperature, moisture movement and ground friction must be added to the live load stresses, and no adequate method has yet been devised to do this.

Where a surface is intersected by rails it does not appear a cheap solution to use a bituminous filling as shown in Fig. 7, since it is very difficult to compact the filling in confined spaces. It is probably cheaper and sounder to fill in with concrete once the rails have been set. Similarly, in Fig. 8 showing the drain, a cheaper and sounder detail would be as given in the cross-section shown below. This would enable the foundation construction to proceed without the interruption of the drainage channel, which could be shaped and carpeted later. Thus traffic crossing over the drain would not pass over a badly compacted area which must inevitably result at the edges of vertical construction joints.

Referring now to the types of material which may or may not be used in pavement construction, the use of grouted aggregate as advocated on page 339, does not appear to be the soundest




CROSS-SECTION THROUGH OPEN TYPE SURFACE DRAIN.

form of construction. This is because in grouted aggregate as opposed to conventional concrete the stone pieces are placed touching each other and are not completely surrounded by the cement matrix. The mortar is contained in pockets of irregular shape and size. These factors together reduce considerably the tensile strength of the concrete, and since the performance of the paving slab is more sensitive to the tensile strength than to any other variable it requires a much greater thickness of grouted aggregate than conventional concrete. Also, if an intrusion aid is used to enable grouting to proceed smoothly, it will result in air cavities being left in the concrete up to about 4½% to 5% with consequent reduction in strength.

Furthermore, grouted aggregate is made with a much greater water content than is usual in conventional concrete. This is usually evidenced by bleeding and softening of the surface of the concrete, where the greatest strength and density are required. Regarding Item (d) of the disadvantages, experience of concrete work shows that no special precautions are required to prevent surface dusting, which is usually due to either too much water,

too much screeding or too rich a mix. Silicate of soda will coat the surface reducing dusting, but will not materially "reinforce the surface" and so add to the strength of the slab. The aggregate used in the concrete may be of any shape other than flaky, that is available, as with modern methods of vibration compaction can be readily achieved. The larger size aggregate, up to 1½-in. to 2-in., should be used in preference to ¾-in. maximum, which will result in a drier mix for the same workability thus giving a stronger concrete less liable to shrinkage.

Referring to Item (a) of the disadvantages on page 313, it is not quite clear what is meant by "rigid control is required over the specification of the binder to accord with the temperature and humidity conditions obtaining on the site as well as having regard to the traffic to which the pavement is subjected." Generally the grade of bituminous binder is decided on the basis of previous experience, and there is no method of rapid testing on site suitable as a basis of quality control as in concrete work.

Further, it is difficult to see what the author had in mind when dealing with normal characteristics in classifying the viscosity of bitumen as a measure of the hardness. Generally the ring and ball tests and the penetration test are used to measure the ultimate hardness of the bitumen, e.g. after the volatiles are evaporated, while the viscosity test is used to classify the grade of bitumen. In a cut back bitumen of course, the material is quite fluid and only achieves its adhesive and cohesive properties when the volatiles are evaporated. The hardness of the bitumen remaining is quite independent of the viscosity of the material in the "cut back" state as the viscosity may be appreciably altered by varying the flux.

The bitumen is frequently stiffened up by the addition of a filler, and the author's experience is unusual in that he finds too much filler causes the asphaltic binder to be doughy, which I interpret as not stiff enough, and to little filler causes harshness, inferring bad workability. The general trend of opinion seems to hold that the opposite effects are obtained.

On the matter of repairs to any existing pavement the available methods surely depend on the cause of failure. There are four general causes of pavement failure.

(a) Pavement thickness designed for smaller loads than those now applied.

(b) Failure of the sub-grade or base due to altered conditions, e.g. increase in moisture content leading to a weaker sub-grade.

(c) Poor workmanship or incorrect specification of the materials.

(d) Incorrect pavement design thickness.

The first case can usually be dealt with by adding a concrete slab or a bituminous carpet even to an existing pavement which has cracked. This method has been successfully used in airfield construction in the past.

In the second case it is generally the cheapest plan to improve the drainage conditions in order to achieve uniform moisture content of the sub-grade and sub-base. In conjunction with this it may be necessary to cut out isolated pockets of bady affected sub-grade material and to reseal the pavement surface, but the author's recommended treatment of taking up and relaying the whole surface over presumably large areas seems unnecessarily drastic.

The remedy for cases (c) and (d) must depend on the extent to which the pavement has deteriorated under loading. While the condition of the pavement might necessitate complete reinstatement, it might be possible to reinstate badly affected parts and add thickness to the pavement with either concrete or bitumen.

The question of remedial measures is bound up with other factors such as fixed pavement levels, drainage, and kerbs etc., as well as cost and availability and no guidance other than in the most general terms can be given.

Yours faithfully,

Camberley, Surrey. M. GAYNOR, B.Sc., A.M.I.C.E.
8th April, 1960

# Obituary

### A. G. VAUGHAN-LEE, M.I.C.E.

We regret to record the death, early this month, of Alec George Vaughan-Lee in his 92nd year.

After being educated at Walton Lodge and Eton College he served a pupilage under Stothert and Pitt, Ltd. of Bath. In 1889 he joined Sir John Coode as his Assistant in design and construction of the first sea wall at Hodbarrow Mines, Cumberland, and in 1890 transferred to Coode, Son and Matthews' London Office. In 1892 he was engaged as an Assistant Engineer on the construction of the Prince of Wales Pier, Dover, and in 1905, having previously acted as Chief Assistant, he became Superintending Engineer of the Admiralty at Dover Harbour. In 1911 he was appointed Chief Engineer to Coode, Son and Matthews and later, in 1921, was taken into partnership until his retirement in 1956.

He was responsible for the design and execution of various structures including harbour and dock works at Famagusta, Singapore, Prai, at Port Sudan and Jersey, and the following bridges—Valley Bridge, Scarborough, the Haven Bridge at Great Yarmouth, the Abu Deleig and Khartoum-Omdurman Bridges in the Sudan, and dams and barrages on the R. Nile including the Mohammad Aly Barrages near Cairo, a flood relief scheme on the R. Euphrates and the Kut Barrage on the R. Tigris in Iraq.

He was a former Member of the Council of the Institution of Civil Engineers, a Member of the Panel of Engineers appointed in 1943 to report on the Severn Barrage Scheme, and was awarded the Order of the Nile and the Order of the Khedive Ismail by the Egyptian Government for his services to Egypt.

### LORD AMMON

The death took place on 2nd April at the age of 86 of Lord Ammon, P.C. former chairman of the National Dock Labour Board and at one time Parliamentary Secretary to the Admiralty.

Charles George Ammon started work at the age of 12 and, after studying at night school, joined the Post Office as a telegraph boy. He spent over 24 years with the Post Office and became trade union organiser for all the Post Office workers. He entered Parliament in 1922 as Labour member for North Camberwell and, with one interval, continued to represent that constituency until he was raised to the peerage in 1944 for political and public services.

His association with the dock labour industry began in 1944 when he became chairman of the then National Dock Labour Corporation, Ltd. When that organisation was reformed as the National Dock Labour Board in 1947, Lord Ammon steered the Board through its early formative years. He resigned from the chairmanship in July 1949 at the direct request of Mr. Attlee after the Labour Cabinet had repudiated a statement he had made criticising the Government's handling of the London dock strike. At the same time he resigned from his posts as Captain of the Gentlemen-at-Arms and Chief Government Whip in the House of Lords.

In 1924, and from 1929-31, he was Parliamentary Secretary to the Admiralty. He became Mayor of Camberwell in 1950 and was made Freeman of the Borough in 1951. A former member of the Select Committee on National Expenditure, he was also a member of missions to China, West Africa and Newfoundland, and of the Privy Council Committee on the constitution of the Channel Islands.

# Construction of a Quay Wall at the Port of Matadi, Belgian Congo

Matadi is situated on the River Congo at a distance of about 110 km from the sea and immediately downstream of the rapids beyond which navigation by sea-going vessels is impossible. The port is the starting point of the railway to Leopoldville and handles over fifty per cent of the maritime trade of the Belgian Congo, which has more than trebled in volume over the past five or six years. Completion of the important hydro-electric works at Inga, some 20 km upstream of Matadi, will further enhance its economic status.

The River Congo is one of the largest rivers in the world. It has an average discharge of 33,000 $m^3$/sec in the dry season and 80,000 $m^3$/sec when in flood. In this respect it is second only to the Amazon, for which the corresponding figures are 60,000 and 150,000 $m^3$/sec, and far surpasses the Mississippi, for which the discharge rates at low and high water are 8,500 and 40,000 $m^3$/sec respectively. For comparison, a typical medium-sized European river such as the Rhone has a maximum discharge of only about 2,300 $m^3$/sec. The velocity of the current in the Congo is higher than that of most other rivers of comparable size, namely, about 1.7 m/sec over a large part of its course, with local "peak" values as high as 4.5 m/sec. The maximum current velocity of the Amazon is only 1.3 m/sec, that of the Rhine is 3 m/sec at Basle and 2 m/sec at Strasbourg, while the Rhone in flood attains a maximum velocity of 5 m/sec below the point where it is joined by the Durance.

The Congo downstream of Matadi comprises three fairly well-defined portions. For the first 50 km or so the river is about 1 km wide, flowing between relatively steep rocky banks (granite and metamorphic lava), with a depth of 40-50 m (and as much as 80 m in places). Over the next 60 km of its course the river is about 5 km wide, with numerous islands and sand-banks. Finally, the mouth of the river is formed by an estuary, 19 km in width and studded with continually shifting sand-banks and submerged bars. The tides mount the river as far as Boma. They are imperceptible at Matadi, where the only variations in water level are due to the seasonal floods, the maximum range being about 8 m.

The quay wall described in this article is a "gravity" type wall of conventional design, constructed of precast concrete blocks. It is remarkable mainly for three reasons:

(a) the considerable depth of water (max. 23 m) in which it was constructed; the new quay at Matadi is probably the highest block type structure of its kind in the world.
(b) the very strong current, which greatly hampered the work of construction;
(c) the unusual subsoil conditions and, in particular, the presence of some exceptionally hard rock.

Fig. 1

The new quay, which is 700 m in length, is an extension of a 1,000 m long existing quay. The latter provides a minimum depth of water of 8.5 m and is capable of accommodating vessels up to 11,000 tons gross. The old quay consists of a deck structure carried on steel screw piles, the earth fill on the landward side being retained by a 6 m high "gravity" type wall constructed of concrete blocks. This form of construction, which was first employed at Matadi some forty years ago, presented various disadvantages and was not considered to be suitable for the new deep-water extension of the quay.

### Alternative Designs Considered

At the design stage three possible alternative solutions were investigated.

(a) A quay consisting of a precast reinforced concrete superstructure (beams and decking) supported on reinforced concrete cylindrical piers, which are connected in pairs by capping beams so as to form a series of portal frames at right angles to the quay and spaced at 15 m centres (Fig. 2). The cylinders are constructed of hollow tubular sections, of 3 m external and 2 m internal diameter, and filled with concrete. They are each provided with a base, or footing, concreted under water.
(b) A "gravity" type quay wall constructed by hollow precast concrete blocks subsequently filled partly with concrete and partly with rubble (Fig. 3). The superstructure is concreted in situ. The use of hollow blocks has the advantage that the blocks can be constructed to larger dimensions for a given maximum weight, so that the number of handling operations is reduced in comparison with those required in building a wall composed of solid blocks of concrete.
(c) A "gravity" type quay wall constructed of 100-ton solid precast concrete blocks, with an in-situ superstructure (Fig. 4).

### Advantages of Gravity Type Wall

A careful comparison of advantages and disadvantages showed this latter solution to be the most satisfactory for the present purpose, i.e., the construction of a wall in deep and fast-flowing water. It had the great merit of simplicity, providing a strong and stable structure, requiring little or no maintenance. It was a well-established, "classic" form of construction, with little likelihood of unforeseen snags arising from the structural design itself, and affording a considerable margin of safety against mishaps due to accidental overloading (collision of vessels with the structure). In addition, the blocks, of simple shape, would be manufactured in a precasting yard under favourable conditions of quality control.

To obtain a suitably level base for the quay wall, a shallow trench had to be formed in the longitudinal direction of the structure, involving the excavation of rock and a certain amount of overlying alluvial material. For the most part the rock was of medium hardness, disintegrated at the surface. There was, however, one relatively small region of exceptionally hard rock which the preliminary trial borings had failed to reveal and which, for a time, presented a serious obstacle to the progress of

the work. The rock in question was a rare geological formation, a volcanic "chimney" of quartzose epidotite with the extremely high crushing strength of 4,870 kg/cm², exceeding that of the hardest known rocks such as basalt (which has a crushing strength of 4,500 kg/cm²). Its hardness was more than 6 on the Mohs scale and was greater than that of ordinary steel. The specific gravity of this material was 3.25.

Attempts to shatter this rock by percussion—using a machine with a chisel fitted with a 12-ton drop weight operated from a rig installed on a pontoon—were quite ineffectual. Considerable difficulties arose not only from the hardness of the rock, but also from the strong current, which made the manœuvring and accurate positioning of the pontoon an awkward and time-consuming operation. This method was soon abandoned, and it was decided to drill blast-holes in the rock by means of two compressed-air-driven percussion drills mounted on a special drilling platform consisting of a pontoon supported on the bed of the river by means of four "spuds" (legs). Although this arrangement enabled the effect of the current to be overcome, it also had to abandoned after a time, as the rock was too hard: there was considerable wastage of drill bits, and the rate of drilling attained was barely 20 cm per hour. Finally, the contractors had to recourse to rotary rock drills equipped with diamond bits. With these machines reasonably satisfactory progress was achieved, though the bits had to be renewed every 10-15 m of hole drilled.

**Difficult Blasting Operations**

The blast-holes were initially charged with explosive by divers working on the river bed. These men had a particularly difficult and dangerous job, as they had to operate at depths of nearly 25 m in inky black water with a very strong current and eddies that continually threatened to sweep them off their feet. To give the divers some protection against the current while charging the holes, a kind of screen was provided by suspending a curtain of rolled steel channel sections from a pontoon. This proved to be an unwieldy and ineffective device. A sort of protective box or pen, 4 m by 4 m in size and constructed of scaffold tubes sheathed with planks, was equally unsuccessful, inasmuch as it was seized by the current and swung about, so that it was almost impossible to manœuvre it into the correct position on the river bed. Finally, a smaller box was employed, which was securely fixed to the drill pipe of the drilling platform.

It was initially attempted to fire a large number of blast-holes simultaneously, with the aid of detonating fuse. Damage to the fuse due to rubbing against the rock, in consequence of the current and the eddies, resulted in failure to explode all the charges. The holes were thereupon recharged and fired singly or in groups of two or at most three, using electric detonators. At first, the holes were charged with explosive by divers. Subsequently, however, charging was done directly from the surface of the water through tubes. About ten blast-holes per shift were fired in this way.

Excavation of the softer material—of which there was only a fairly small quantity—was done by means of grabs worked by a crane mounted on a pontoon. Something like half the working time was lost in manœuvring the pontoon and getting the grab into the right position. This method of excavation was subsequently abandoned in favour of a 300 h.p. multi-bucket dredger which loaded the material into barges. This proved to be a more satisfactory procedure, though manœuvring and mooring the dredger again presented unavoidable difficulties in consequence of the current.

The base for the quay wall was levelled by divers. The stones used for forming the base were dropped to the bottom of the water through telescopic pipes from a pontoon, which was manœuvred in accordance with telephoned instructions from the divers. This work of forming and levelling the base proceeded behind the concrete blocks which had already been installed in position upstream of the divers and which protected them from the full force of the current. Once the base had been levelled, the placing of the blocks was a relatively simple matter. They were handled and lowered by means of a floating crane. These operations presented no special difficulties.

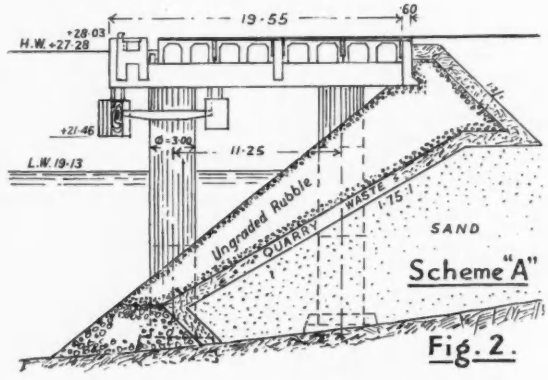


Fig. 2.

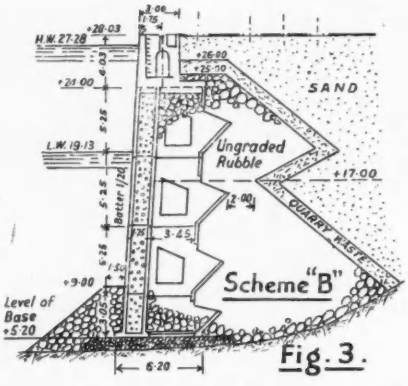


Fig. 3.

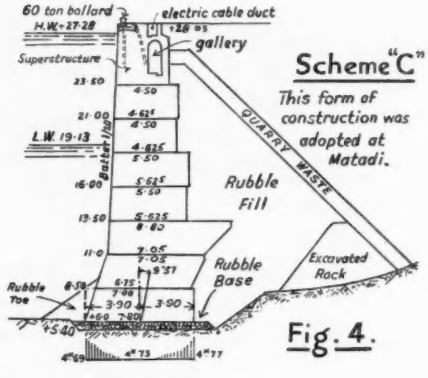


Fig. 4.

**Port Improvements in North Viet Nam**

Plans for the reconstruction of the Port of Haiphong have been accepted by the Vietnamese Government. The work will be undertaken in two stages, the first of which will comprise the installation of cargo handling facilities and the introduction of mechanisation, which will increase the port's capacity by about a quarter. The second stage will include new berthing facilities which are to be built on the Kya Kam River and in Bai Tai Bay and will be capable of accommodating ships of large tonnage.

Improvements are also recommended for the Port of Hong-gai, used almost exclusively for the shipment of coal from the adjacent anthracite mines, the output from which constitutes at present the major item in Viet Nam exports. In anticipation of increased production and export of coal, sheds are to be built for the storage of coal awaiting shipment and new electric gantry cranes are to be installed. The power supply system is to be expanded and new railway sidings are to be made to meet the increased trade.

# Reinforced Plastics in Buoy Construction

By W. G. BROOKER
[Gas Accumulator Co. (United Kingdom) Ltd.]

Two months ago Trinity House laid a prototype plastic light buoy in the Southern half of the Cork Hole, off Harwich. It is to stay in this position for at least a year so that the influence of the sea upon this revolutionary application of reinforced plastics may be studied under actual service conditions.

The general form of this buoy has become familiar to many people as a result of its having been the basis of the television serial, " Starr & Co.", which was broadcast during 1958, and, in fact, the original prototype which was used in that serial has been moored in the Thames at Brentford ever since it was placed in the water by " Joseph Starr and his staff." Here it was subjected to stability and other tests and continues to serve a very useful purpose in that the effects of long exposure are under constant observation.

As a result of the information and experience gained in this way, a second prototype was made. The modifications embodied in it were purely of a constructional nature and directed towards strengthening the buoy mechanically to meet the severe mechanical stresses which the sea imposes. It was not found necessary to alter the general form of the buoy, its riding characteristics having been found to coincide very closely with the original calculations and to be entirely suitable for the service for which it was designed. (See Fig. 1).

This is the prototype buoy which is now in the North Sea.

**Plastics at Sea**

Glass fibre reinforced plastics are of comparatively recent introduction into this country and when one meets a material which combines strength with lightness and resistance to corrosion, the natural tendency is to attempt to apply it to the field in which one is particularly interested. If this should be connected with the sea, then the desire to use such a material is very great indeed because the sea is a very severe master both chemically and mechanically.

To the designer of light buoys, the reliability of which must be beyond doubt, reinforced plastics appear to offer an answer to the so far unattainable demands of the Buoyage Authority for lightness and resistance to corrosion, to assist them in their important work of maintaining these navigational aids. It soon becomes evident, however, that it is unwise to adopt a design which is based upon steel. Apart from the differences in mechanical properties of the two materials, due regard must be paid to the economics of the change, the cost of the glass and resin being several times that of steel, weight for weight.

In designing this buoy, therefore, the problem was tackled from first principles and this resulted in a rather novel design having a number of accidental features which, in the preliminary stages at least, were not sought.

**Choice of Service**

In considering the design, it was first necessary to decide upon the service it would be expected to give. It was found that by far the greatest demand among Lighthouse and Buoyage Authorities is for a skirt keel buoy which will support a 200 mm. lantern and flasher about 11-ft. or 12-ft. above sea level and which will carry four A-50 acetylene accumulators, which are sufficient to supply a flasher with a 20-litre burner for one year.

This equipment together weighs about 12 cwt. and is normally carried in an 8-ft. or 10-ft. steel skirt keel buoy, which, fully equipped, weighs something like 6 tons.

It was decided to attempt the design of a buoy to fulfil this service since such a buoy would be of the widest possible benefit especially to the many authorities with limited facilities.

**Construction of the Buoy**

It is seen that the essential equipment of the light buoy consists of acetylene accumulators contained in a watertight housing which supports a lantern with its flasher and radar reflector some 10-ft. or 12-ft. above it.

If this equipment were embodied in a rigid structure, it could be made to float by attaching a buoyancy chamber round it and the proper riding characteristics could be imparted by adding a suitable amount of ballast to the bottom of the accumulator housing. Basically, this is the form of construction which has been adopted for the AGA Buoy.

Fig. 1.

The general method of construction is shown in Fig. 2, from which it will be seen that the ballast weight supports the centre cylindrical accumulator housing and the half-ton of acetylene accumulators which it contains. Betwen the ballast weight and the radiating arms at the top of the accumulator pocket is a rigid framework of castings and rods. The lantern is carried on a trestle supported by four radiating arms which also embody lifting eyes. The lower castings springing from the ballast weight form a platform to which are clamped eight segmental buoyancy chambers.

Collisions in closely navigated waters are not infrequent and steel buoys often suffer considerable damage. It is unlikely, therefore, that plastic buoys will escape damage, but it may be that because of their lightness they will suffer less. However, the employment of a number of separate buoyancy chambers is a considerable safeguard against the loss of the buoy and its equipment by sinking since three chambers are sufficient to support the buoy.

Fig. 3 shows the buoy being lowered over the side of the Trinity House tender immediately prior to its being laid. This shows clearly the other features in the design and construction of the buoy. These are as follows:

**Fender.**—The fender is a segmental one made of reinforced plastics and assembled with neoprene discs to provide a cushioning effect. As will be seen from the photograph, it encircles the prototype buoy at the waterline, but, in deference to a good deal of opinion, provision has been made for a fender to be fitted around the top of the buoy body, either alternatively or additionally.

**Trunnion Mooring Eyes.**—In order that the buoy should ride in an upright position in a current or tide, it is important that the point of attachment of moorings should coincide with the underwater centre of pressure of the buoy. This latter occurs some distance up the buoyancy chambers so that solid mooring eyes would have to project appreciably. Trunnion mooring eyes have, therefore, been adopted and this neat method of attachment of moorings can be clearly seen.

The trunnion arms are bushed and these bushes and the stainless steel pins on which they oscillate are replaceable.

**Trestle and Daymarks.**—The trestle is of tubular construction for strength and lightness. It is intended to develop segmental interchangeable daymarks (can, cone and sphere) which may be attached to the trestle according to the service required.

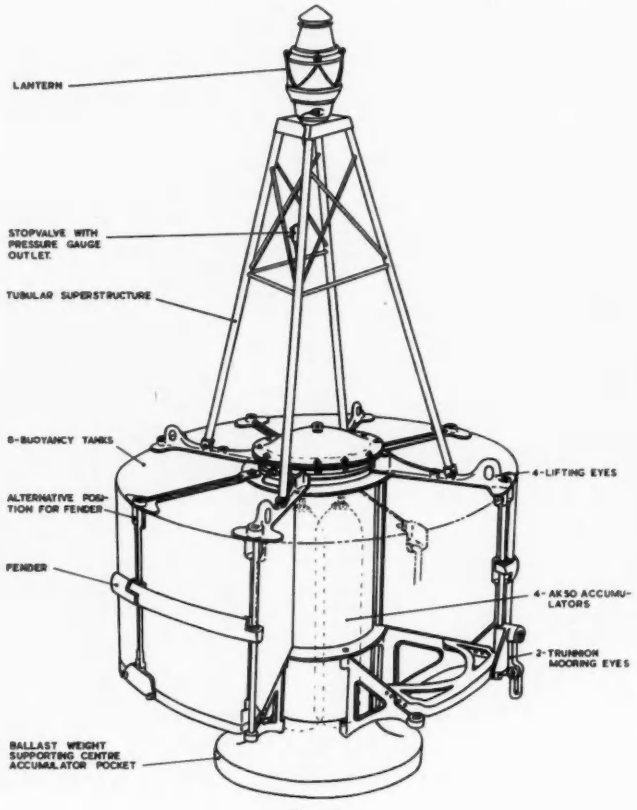



Fig. 2.

## Materials

The plastic components are made of 1½ oz. chopped strand mat impregnated with polyester resin containing a black pigment. Other buoys are now under construction for Government Departments, and very good results, using yellow and red pigments, have been achieved.

Where greater strength is required, a woven glass cloth has been introduced into the laminate. To form strengthening corrugations inside the buoyancy chambers, wood of half round section has been incorporated, but it is the formed corrugations, and not the wood, which are relied upon.

Turning to the metal components, the choice of a suitable metal was an anxious one and many possibilities were examined. Having regard to all the factors involved, not forgetting the economics of the project, the final choice fell upon spheroidal graphite iron. Its ability to withstand shock and resistance to corrosion commended it.* The metal components of the initial buoys are being hot galvanised and painted with plastic paints.

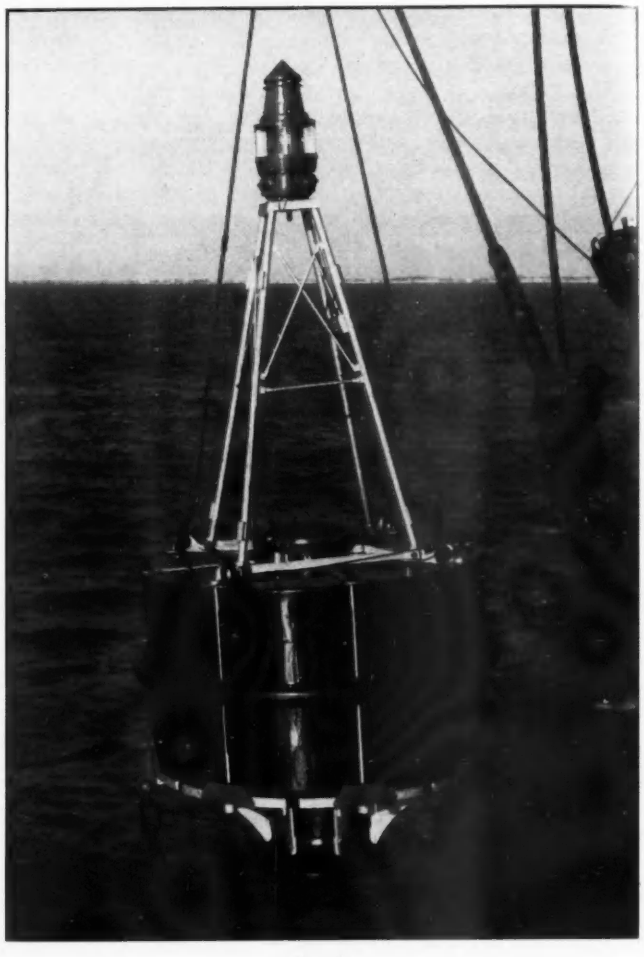


Fig. 3.

This is briefly the line of thought which was followed in the development of the AGA Plastic Buoy, but a number of other minor considerations have exerted their influence. The adoption of eight segmental buoyancy chambers was decided upon as a safeguard against loss in collision which this affords. It would, however, have been equally safe had there been only one chamber in the form of a ring, but divided into watertight compartments by bulkheads. Alternatively, this single ring could have been filled with a cellular plastic foam to have achieved much the same purpose. But the multi-chamber design has the advantage that damaged chambers can be moved and replaced on the deck of the buoy tender without disconnecting the moorings.

Damaged chambers are, of course, repairable, but this is better done in the more easily controlled conditions in a depot rather than at sea. The equipment required for repair is simple and

(*concluded at foot of following page*)

*"The Dock and Harbour Authority" hopes to publish technical data on this relatively new iron in the near future.

# New Firefloat for Swansea Docks

Each year 3,000,000 tons of crude oil is imported by The British Petroleum Company at Queen's Dock, Swansea, for refining by BP Refinery (Llandarcy) Ltd., and subsequently, a whole range products varying from motor spirit to fuel oils, is exported.

To deal with an outbreaks of fire on tankers while in the port an unusual craft—named the "BP Firemaster"—has been designed by the Engineering Department of BP Tanker Company on the basis of experience gained in using sea-going tugs for fire-fighting duties. These specially equipped sea-going tugs have their place in some conditions, but are not suited economically to in-dock working and, due to their dual purpose, they have disadvantages over a specially designed craft. In particular, in some conditions a tug cannot maintain a steady position close to the scene of the fire, due to the reaction from the force of the water jets which tends to push the tug away. The exception is where the tug is fighting the fire head-on when it can use its engines to counter the force of the jets, but even in this case a strong cross wind can make it difficult for a tug to keep its position. Another disadvantage of the orthodox fire-fighting tug is its inability to use the maximum number of mechanical jets in any one direction.

The Swansea firefloat has been designed with a single purpose in view. Its engine arrangement will enable it to move it any direction, or conversely to maintain its position against the force of the water jets and wind forces, regardless of the direction in which they are used. The water jets are so arranged that seven of the nine can be used in any direction simultaneously.

The main features of the "BP Firemaster", which has been constructed for the BP Tanker Company by R. S. Hayes (Pembroke Dock) Ltd., are two 33-ton pontoons, each 60-ft. long and 14-ft. wide, and spaced 8-ft. apart. These pontoons are joined together at deck level, and also at their base by elliptical tubes to form a "catamaran". Surmounting the catamaran hull are four tubular supports which form a tower on which two platforms and a control cabin are mounted.

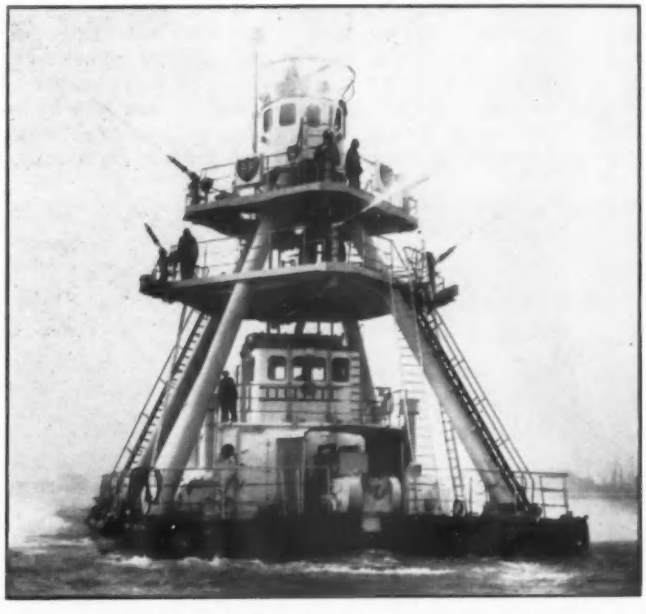
The fire-fighting layout has been designed in collaboration with Merryweather and Sons. There are a total of nine 4-in. gear operated fire-fighting nozzles, or 'monitors' as they are generally known. Four of these monitors are mounted on the lower platform which is 23-ft. above deck level, four are fitted to the middle platform at about 30-ft. above deck level, and one on the top of the Chief Fire Master's control cabin which is at the top of the tower. The tower has a total height of about 40-ft. above water level, so that water or foam can be directed on to the decks of any tanker, whether in light or loaded condition.

The fire-fighting and salvage pumping capacity of the firefloat is 4,000 gallons of water per minute at 100 lb. per square inch, and the foam capacity is 12,500 gallons per minute. Water or foam can be discharged from any one or a number of the monitors independently, giving the Fire Master full mobility of water or foam requirements.

In addition to the main pumping units each pumproom contains an 11.5 KW generator direct driven by a Lister-Blackstone FRBMA diesel engine developing 24 BHP, a belt driven 3 KW 24/32 volt batteries, a motor-driven Gilkes Gordon bilge pump and a motor-driven Hanworthy foam pump.

Propulsion of the firefloat is by two Harbormaster outboard propulsion units situated at the forward and after ends, and each operated by Dorman KUD 6-cylinder diesel engines of 140 BHP and fitted with Bryce Berger "Handraulic" starting. Both these units can be started and operated from the wheelhouse, and as each propeller can be rotated through 360 degrees, movement in any direction can be obtained, and the firefloat held in any required position against the thrust of the monitor jets.

Among the special facilities in the Chief Fire Master's control cabin is a loud-hailer talk-back system to enable instructions to be given to the navigation house, engine rooms and the firemen manning the monitors. A portable walkie-talkie wireless set can also be used.



"B.P. Firemaster" undergoing trials in Swansea Harbour.

An interesting feature is the fitting of heavy lorry wheels at the forward and after ends of each pontoon to assist the movement of the firefloat along the side of a ship.

When not in use, the "BP Firemaster" will be moored alongside a small jetty in Queen's Dock by quick release mooring ropes, and will be maintained permanently ready for service with a regular crew of two, one man for navigation purposes and the other for starting up the diesel driven fire pumps and and propulsion units. All the engines are push-button started so that water or foam can be available at any monitor within a few seconds.

On the main deck between the pumproom skylights is the accommodation for the watch-keepers, consisting of a well fitted-out cabin with settees, tables and lockers. On the port side of this cabin there is a small galley, and to the starboard side, toilet accommodation. The cross alleyway at the after end gives access to port and starboard pumprooms.

The fire-fighting personnel will be drawn from the Swansea Fire Service who will be able to man the firefloat within three or four minutes of call and the float will be under full control of the Chief Fire Master.

## *Reinforced Plastics in Buoy Construction*—*continued*

the work can be carried out by a labourer of average intelligence after brief tuition.

Another factor which influenced the design was the advantage of being able to disassemble the buoy piece small for transport overseas. The cost of transporting the conventional steel buoy bears heavily against sales in overseas markets. This feature is also an advantage to authorities in this country in that they are able to transport buoys from depot to depot without special transport.

It remains to see how the buoy will stand up to the conditions at Harwich. Other buoys are nearing completion and will be moored in positions at home and abroad where they will be severely tested by the stresses and strains of sea and air.

# Manufacturers' Announcements

## Shipyard Cranes

Since the war, most shipbuilding companies in the United Kingdom have carried out extensive reconstruction schemes in order to take full advantage of new methods of welded construction. For service on the berths, travelling cranes of large capacity are necessary and some controversy has developed regarding the best type of crane to undertake the duties required. Various shipyard engineers have investigated this matter and some have come to the conclusion that the cantilever crane is the machine best suited to their requirements. This design of crane provides positive structural support for the load throughout except for the hoisting ropes, level line operation between maximum and minimum radius and a small minimum radius which avoids excessive use of supplementary motions for load positioning.

It is contended that cranes with long jibs sustained by derricking ropes provide certain undesirable features. Apart from wear on derricking ropes, inspection and maintenance is hazardous due to inaccessibility and the replacement of ropes presents a problem in sustaining the jib since any interference with an unbalanced suspension system is dangerous. This disadvantage does not, of course, occur in jib cranes if positive jib balancing

is achieved or where mechanical linkage or screws provide the actuating medium.

The height of shipyard berth cranes is determined by the clearance required from the ships hull but with cantilever type cranes an excessive load suspension distance is avoided throughout the operating range compared with jib type cranes which usually have a much greater height to the point of the jib. In shipyards where accurate spotting of the load is desirable, this is an important feature since it may be necessary to suspend loads for a protracted period while joint connections are made.

Sir Wm. Arrol and Co. Ltd., have supplied many shipyards with electric travelling cantilever cranes up to 60 tons capacity and the recent development in the West Yard of Messrs. John Brown and Co. (Clydebank) Ltd. is typical of many such installations. The accompanying photograph illustrates the layout which comprises one 60 ton Undertrussed Travelling Crane, one 60 ton Overtrussed Travelling Crane, one 60 ton Overtrussed Fixed Crane and one 40 ton Overtrussed Travelling Crane. Where cantilever cranes are used on common tracks, or they overlap, it is customary to alternate between overtrussed and undertrussed types for clearance purposes. Proximity devices are fitted which indicate to the operators the relative positions and movements of adjacent cranes.

The travelling cranes operate on tracks at 32-ft. centres and each is mounted on a total of 16 rail wheels or 4 rail wheels at each corner carried on equalising bogies and driven by twin motors which are electrically connected. The current supply to the cranes is collected by means of large radial type weight operated cable drum fitted with suitable lengths of flexible trailing cable.

Twin drives are also employed to slew the cantilevers through reductions of worm and spur gearing to pinions which engage large diameter pin racks. Easily adjusted slip devices are embodied in the motion to prevent excessive overloads on the gearing during periods of acceleration and deceleration. Each cantilever is supported on a large spherical roller footstep bearing running in oil mounted at the bottom of the mast while horizontal rollers adjustably mounted on bogies engage a roller path fitted at the top of the tower.

On the trolley, which carries the main hoist return pulleys, an auxiliary hoist winch of 5 tons capacity is fitted and the trolley is traversed along the front cantilever by means of racking gear which is positioned at the end of the rear cantilever adjacent to the main hoisting gear. A change gear operated from the drivers cabin provides for alternative speeds on the main hoist.

British Standard Crane Specifications provide for an operational wind pressure of 5 lbs. per square ft. with an out of service allowance of 30 lbs. per square ft. In the case of shipyard cranes manufactured by Sir Wm. Arrol and Co. Ltd., the service wind allowance is increased to 10 lbs. per square ft. (approximately 55 miles per hour) as it is recognised that it might be necessary to suspend the load for a protracted period. It is dangerous to handle bulky shipyard loads in wind pressures above this figure, since they tend to become unmanageable—whatever type of crane is employed. Anemometers are fitted to give visual and audible warning of gale conditions and anchorages are also provided to secure the cranes under these circumstances to the tracks.

## American Portable Dredge

The " Hydra-Drive " portable dredge manufactured by American Marine and Machinery Company, Nashville, Tennessee, U.S.A., has a new drive system which is claimed to give twice the power with variable speed swing and cutter. A ladder having removable sections is provided to give efficient dredging at variable depths and, if necessary, an additional engine can be installed in the field to drive the pump without loss in capacity when pumping at extreme distances or elevations.

The compact " Hydra-Drive " system enables this dredge to be completely portable and easily assembled in two days ready for operation, enabling the dredging contractor to do the many small jobs that arise in different locations. Less maintenance is needed than with the normal dredge, because there are 80 per cent less moving parts to wear out. A control system for all machinery is housed in an elevated control room, giving complete vision of dredging operations.

Production model portable dredges are available from stock in 8-in. to 18-in. sizes on lease or sale basis. The Company also builds and designs custom dredges, towboats, barges, and workboats.

## Expansion Jointing Development

Tretol Ltd., in conjunction with Servicised Products Corporation of Chicago, U.S.A., have commenced to manufacture in the United Kingdom the well-known range of Servicised expansion jointing materials. These will be marketed through the newly formed Tretol-Servicised Ltd. Products will include Kork-Pak, a pre-formed joint filler available in a wide variety of thicknesses up to 1-in. and showing a maximum loss of only 3% of its weight after compression, as well as a comprehensive range of other expansion jointing products.

Another product new to this country is the patented Split Type Rubber Waterstop, which has been widely used in the United States. The advantage of this type of seal is that it reduces the

need for complicated split form work and so reduces installation costs.

There is a wide range of sealing compounds available for use in expansion jointing. Para-Plastic 41 and 44 will be of considerable interest, as these sealing compounds possess such a high standard of adhesion that primers can be completely eliminated. Road Research Laboratory experiments have revealed that the type of sealing compound giving the best results was found to be a material conforming to American Federal Specification SS-S-164(1), and to this Para-Plastic 41 fully complies while at the same time meeting the penetration requirements of British Standard 2499.

Tretol-Servicised Ltd. aim to provide technical advice and assistance on all types of expansion jointing problems. Technical literature is available from the Technical Sales Office, 2 Caxton Street, London, S.W.1.

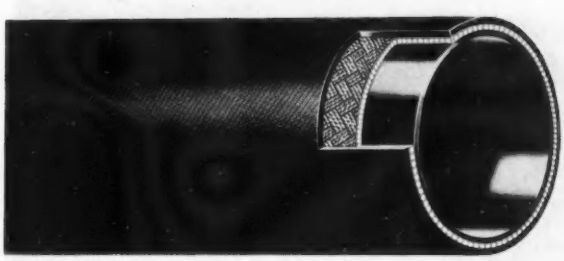
## New Cranes for Middlesbrough

The equipment at Dent's wharf, Middlesbrough, is to be modernised. An order for three new cranes, costing about £60,000, has been placed with Stothert and Pitt Ltd., and it is expected that the cranes, which will replace three of the older cranes at the wharf, will be delivered by the end of the year. The wharf has 13 cranes in operation of a varying lifting capacity, all of which have been supplied by Stothert and Pitt. The new cranes are all-electric and of the latest tubular type embodying innovations which include easy assembly and improved controls. They are hydraulic and can be lowered to ground level for easy maintenance, the jib of each having an operational radius of 65-ft. Cranes of a similar type are now in regular service at the Port of London and the Port of Bristol Authority has also placed an order for a number.

## Development of Heavy Duty Hoses

Recently developed for heavy duty, high pressure service is the Goodyear Fire Chemical Hose (Style 223), which has been specially designed for wash-down duties and fire fighting on tankers with both water and chemical foam. It is also suitable for fire fighting duties in refineries.

The hose, manufactured in 50-ft. or 60-ft. lengths, has a smooth 2½-in. bore which ensures maximum flow. Extremely flexible and light in weight, it has a guaranteed test pressure, on delivery of 400 p.s.i. The tube consists of a smooth, seamless and non-porous synthetic rubber which is reinforced with a



Fire Chemical Hose.

braided, high tensile, synthetic fibre yarn. The synthetic rubber cover gives high resistance to wear and abrasions in addition to withstanding the effects of oils, greases and dilute acids.

Although the hose may be used with several types of fittings, one coupling in particular—the internal expansion ring type, with pin-lug—is supplied and recommended. This is a permanent coupling available with Fire Hose threads.

Another hose developed by the Company for the bulk handling of dry materials is particularly well suited for the transfer from ship-to-shore of cargoes such as grain, dry chemicals in crystal powder form, fertilisers and similar materials which are not highly abrasive. The smooth uniform bore of the tube and its substantial thickness of abrasion-resistant rubber ensure maximum capacity and service.

The Goodyear Dry Materials Hose (Style 273 x 243) is supplied in lengths to suit the site and application. It can be built with enlarged ends for fitting couplings or with soft ends for clipping to existing pipework or hopper feed tubes. The seamless 3/16-in. smooth-bore tube of high grade rubber is reinforced by three piles of strong, close woven fabric and a helix of round, steel wire embedded in the rubber whilst the cover consists of medium-gauge, abrasion-resisting compound.

Lightweight and flexible, the hose has a maximum working pressure of 50 p.s.i. and is made in bore sizes of 2½-in. and 4-in.

## Rubber Fendering Products

The use of rubber fendering for docks, wharves, piers and dolphins is growing steadily with the ever-increasing size of ships and the high cost of steel-and-concrete dock construction.

Rubber fendering at Bede Quay, Hebburn-on-Tyne.

These two factors indicate the necessity of adequate, non-deteriorating fender systems.

The North British Rubber Company of Edinburgh, who are associated with the United States Rubber Company who have carried out installations of marine fendering all over the world, is developing a variety of large rubber fenders for docks, as well as smaller types for light craft, tugs, barges.

An interesting example of dock fendering is the new installation at Bede Quay Hebburn-on-Tyne, where some sixty-six rubber fenders, each 8½-ft. in length with outside diameter of 15 inches have been slung along the quay coping. Each section weighs over 4½-cwt. making an overall weight of about 15 tons.

Another example is the supply of 6-ft. lengths of 7-in. outside diameter hollow core fender as protection for the Clyde Pilotage Authority's pilot boat "Cumbrae". This 100 tons cutter is used chiefly to carry pilots to vessels at the Cumbrae Heads, some 16 miles down the River Clyde. As it is necessary for the cutter to go alongside the vessel requiring a pilot in all weathers, a strongly constructed hull is essential, and to reduce the force of impact to the minimum, the rubber fendering has been slung to lie over a doubling plate at deck level, where maximum strength is obtained.

## Mobile Jib Crane for Handling Bales

Taylor Stoker Co. Ltd., of London, have designed and manufactured a mobile slewing jib-crane to suit the particular requirements of Colonial and Eagle Wharves Ltd. This special-purpose crane was needed to handle more than a thousand bales of wool per day. Only two men are employed for loading; one on the lorry and the other to operate the crane, while a team of porters conveys the bales from the quay and weighbridge.

The lift height of the crane is approximately 18-ft. and the operating radius approximately 10-ft. It is fitted with two-speed motors, providing lifting speeds of 28-ft/min. and 85-ft./min., and travelling speeds of 12-ft./min. and 40-ft./min. The jib is capable of slewing 90° in 6 seconds and can rotate full-circle.

Mobile jib crane loading bales on to a lorry.

All the operating equipment is enclosed with steel casing having removable panels to provide access. Bolted construction was employed throughout and there is a built-in platform with an access ladder. Current supply to the crane is by means of a flexible cable overhead from a power point.

Besides lifting and slewing, the crane is capable of travelling along a pair of rails to suit the loading requirements. It is electrically operated and the controls are duplicated for ease of operation from either side.

## Trailing Suction Hopper Dredger

The Brazilian Government in 1958 ordered from I.H.C. Holland at The Hague a complete dredger fleet, consisting of 2 twin-screw trailing suction hopper dredgers; 1 stationary cutter suction dredger, complete with floating pipeline, shore pipeline and landing pontoon; 1 diesel driven tug of 360 h.p.; 1 service boat; 1 diesel driven floating sheerlegs; 1 diesel driven oil and water barge; 1 barge with a 2 tons mast and derrick and 1 booster station with 20-in. pump.

The first of the two trailing suction hopper dredgers, named "Minas Gerais" was launched from the N.V. Scheepsbouwwerf and Machinefabriek "De Klop" at Sliedrecht on February 24th, 1960. The main dimensions of this dredger are 71.55 m. in length by 13 m. in width and 5.40 m. deep, and she is built to the highest requirements of Lloyd's Register of Shipping. She has a hopper capacity of 800 cu. m. and the hopper well is provided with bottom doors for discharging the spoil at sea. For loading the vessel will be equipped with two flexible side suction tubes, patented by I.H.C. Holland, provided with drag heads of special design. With these a dredging depth of 11 m. can be attained and, in addition, it will be possible to work the dredger in a swell.

The machinery consists of 4 eight-cylinder Stork-Ricardo diesel engines, each developing 525 h.p. and 2 three-cylinder diesel engines each developing 156 h.p. These diesel engines drive a number of generators, providing electric current for the motors, propellers, sand pumps, deck and engine room auxiliaries. The bottom doors of the hopper well are electric-hydraulically operated from the wheelhouse, from which also the complete propelling installation is centrally operated.

The crew will comprise a total of 43 men and the vessel will be equipped with all navigation aids such as radar, radio transmitters, draught indicator, etc. After completion later this year the dredger will sail under her own power to Rio de Janeiro, her port of destination.

The stationary cutter suction dredger "Mato Grosso" and the rest of the fleet have already been completed and are being transported to Brazil. The second trailing suction hopper dredger will follow early in 1961.

## Crane and Hoist Control

Many attempts have been made in the past to produce a device which would go between crane hook and load to accurately measure the load and allow, when some delicate lift was in progress, slow and accurate inching down or up to place it in position with the crane locked. It is believed that Mefco Hydra-Set, a device which has recently been introduced into the United Kingdom, successfully satisfies these requirements.

The Hydra-Set is an entirely self-contained unit, ready for use with any type of crane. The upper eye of the set is connected to the crane line or hook, the lower eye to the load. The crane operator, using his normal controls, brings the load into approximate position above the point where it is to be finally lowered or placed, then sets the crane brakes to hold the load secure. Control of the load then passes to the operator of the Hydra-Set **who is at the visual point of contact** and so can control the final movements independent of the crane operator. The Hydra-Set operator then adjusts the load by means of a control valve which can be operated from a distance by means of a remote control line and reel connected to the lever. With the load safely in place the crane driver releases the brakes and the Hydra-Set then closes automatically ready for another lift.

The Hydra-Set provides rigging aid and when attached in sling lines, permits easy accurate adjustment of the sling lengths; it serves as strain gauge by instantly indicating unexpected loss or gain in registered weight; and it acts as a crane scale, automatically showing the weight of a load as soon as it is suspended on the hook. It is claimed to have considerable possibilities for weighing and adjusting when used on mobile and truck cranes.

The device is manufactured by Mefco Sales and Service Corporation, 131 North Fifth Avenue, Arcadia, California, U.S.A. and is supplied in Great Britain by Cole, Wardlaw and Co., 39/41 New Broad St., London.

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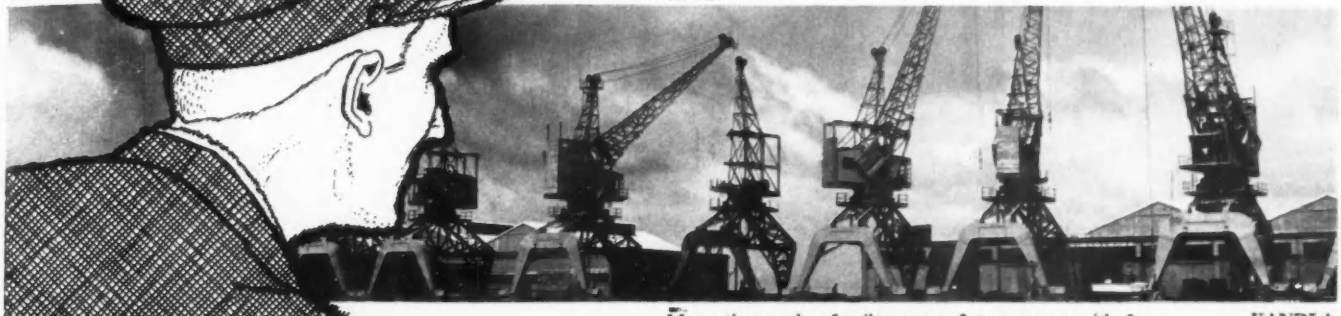
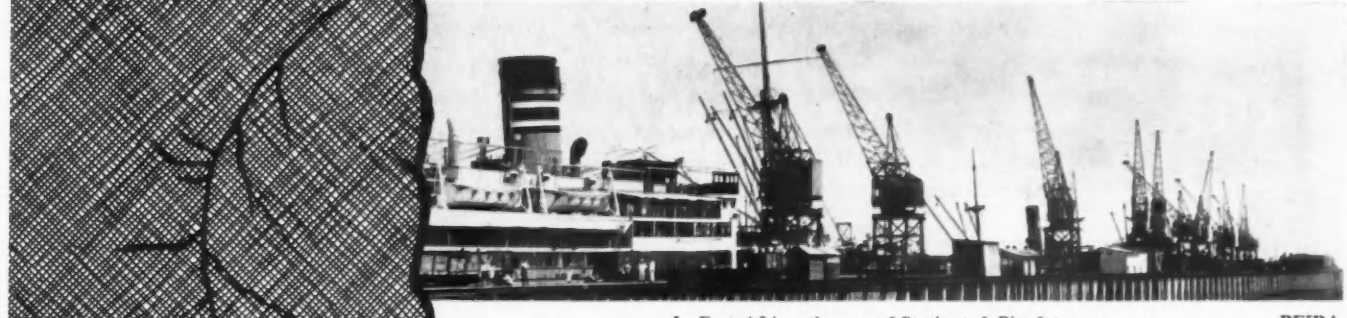
Silhouetted against a grey London sky these Stothert & Pitt 3 and 5 ton cranes with maximum radii varying from 65 ft. to 90 ft. stretch as far as the eye can see.

**P.L.A. LONDON**



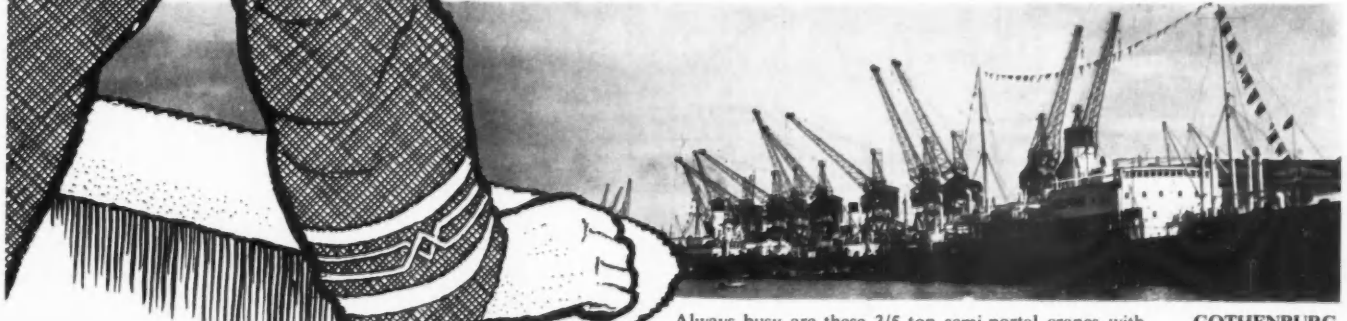
Many thousands of miles away, 3 ton cranes with 3 legged trucks and a maximum radius of 75 ft. speed up cargo handling in India. Also in use at the same port are 6 and 10 ton cranes with maximum radii up to 75 ft.

**KANDLA, INDIA**



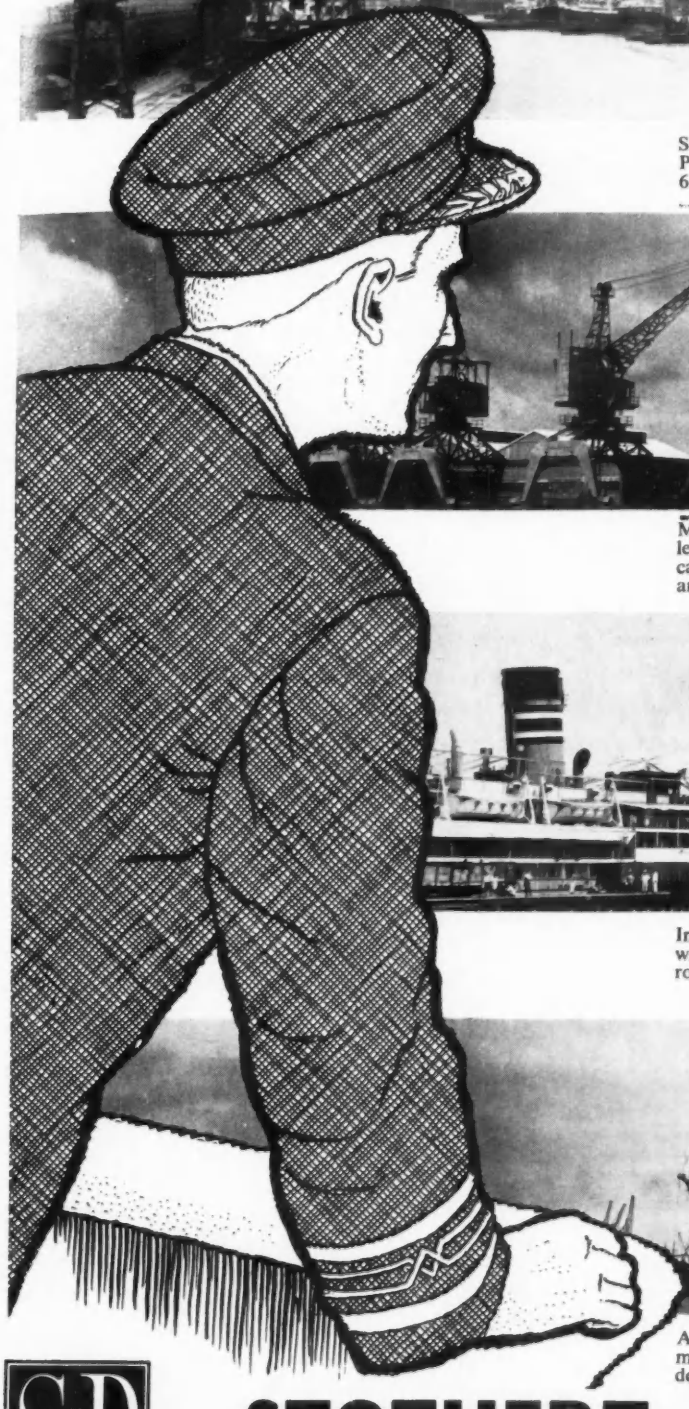
In East Africa, the use of Stothert & Pitt 3 ton cranes with a 55 ft. maximum radius ensures the quick turn round of large cargo ships.

**BEIRA, EAST AFRICA**



Always busy are these 3/5 ton semi-portal cranes with maximum radii of 96 ft. and 69 ft. which dominate a dockside scene in Sweden.

**GOTHENBURG, SWEDEN**



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a new offshore survey system operating on high frequencies using lightweight equipment

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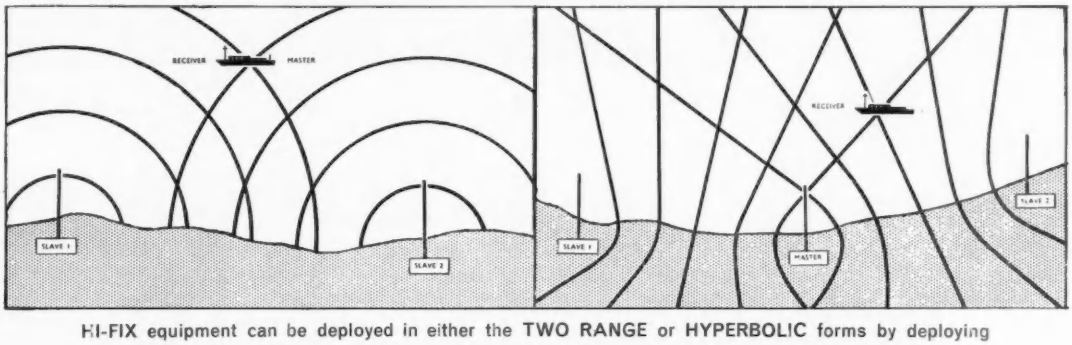
free from the bugbears of 'beat notes', modulated transmissions, multiple frequencies, reference stations, wide bandwidths and interference.

based on the sound principles and employing the same techniques as the Decca Navigator System which is now used in its basic forms by more than 6,000 vessels, to say nothing of the many survey chains throughout the world.




HI-FIX equipment can be deployed in either the TWO RANGE or HYPERBOLIC forms by deploying the master station ashore or on the survey vessel, no equipment changes being required

***TWO-RANGE HI-FIX***

*The two-range version gives the maximum accuracy obtainable from the system with only two shore stations and no lattice charts.*

***HYPERBOLIC HI-FIX***

*The hyperbolic layout provides a high accuracy service for an unlimited number of users simultaneously.*

HI-FIX is the answer for those small inshore areas where Hyperbolic or Two Range Decca is not justified on economic grounds. Normal Decca and Hi-Fix stations can be co-sited to give the precision pattern inshore (lane identified by the normal patterns) combined with the long working range of the normal Decca System.

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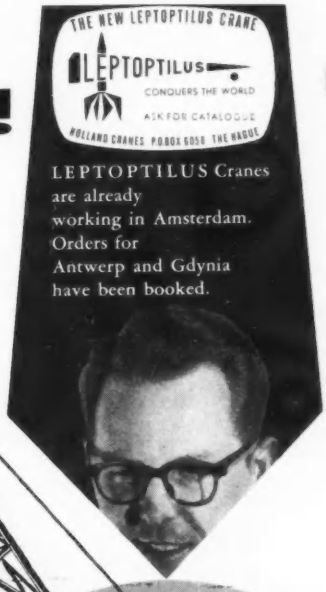
# new!



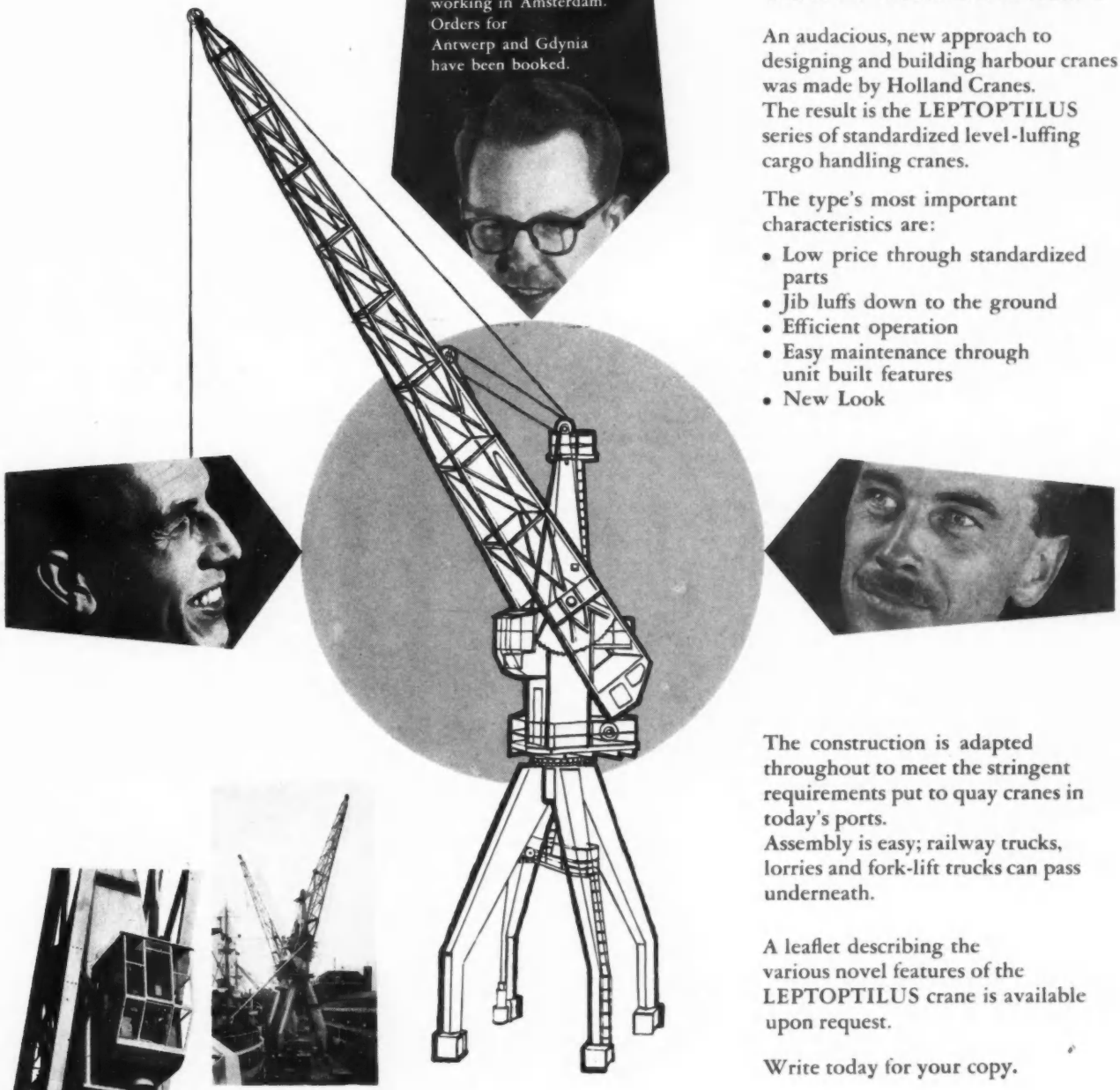

LEPTOPTILUS Cranes are already working in Amsterdam. Orders for Antwerp and Gdynia have been booked.

# ADVANCED LEVEL-LUFFING CRANE NOW ON THE MARKET

An audacious, new approach to designing and building harbour cranes was made by Holland Cranes. The result is the LEPTOPTILUS series of standardized level-luffing cargo handling cranes.

The type's most important characteristics are:

- Low price through standardized parts
- Jib luffs down to the ground
- Efficient operation
- Easy maintenance through unit built features
- New Look



The construction is adapted throughout to meet the stringent requirements put to quay cranes in today's ports.
Assembly is easy; railway trucks, lorries and fork-lift trucks can pass underneath.

A leaflet describing the various novel features of the LEPTOPTILUS crane is available upon request.

Write today for your copy.

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## HOLLAND CRANES

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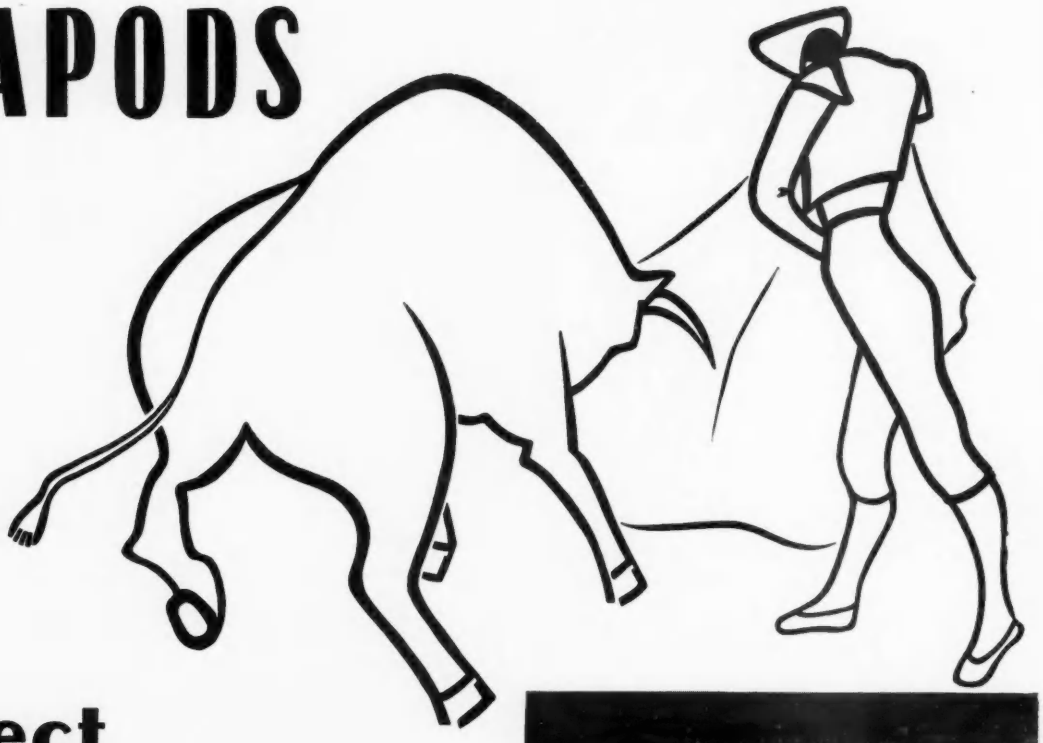
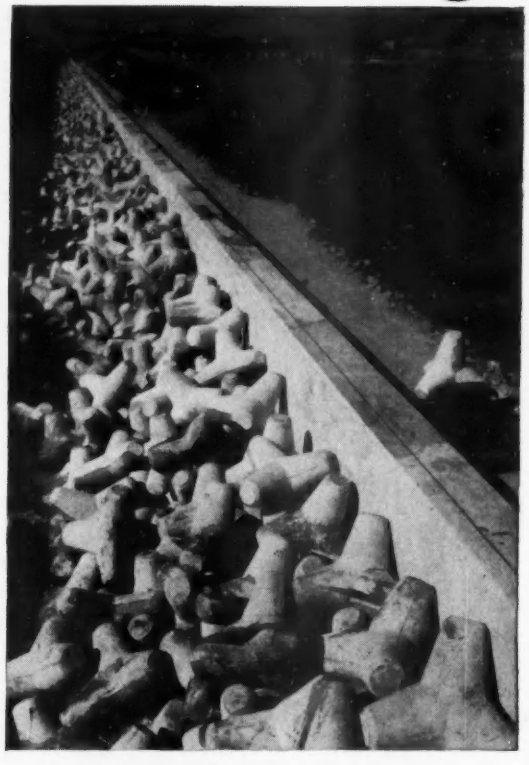
# TETRAPODS



# protect ROTA



**NAVAL BASE AT ROTA, IN CADIZ BAY - Spain**

the jetty is protected by a large embankment of 8, 16, and 25 ton "tetrapods"

## engineers prefer tetrapods

**because they**
**are more reliable, are easily handled, cut costs by 25%**

*it is hard to beat tetrapods when it comes to protecting rubble mound breakwaters. Their sturdy legs interlock forming a tough armour that can be depended upon for its roughness, permeability and stability.*

*Conventional breakwaters cannot stand comparison with equally strong breakwaters using tetrapods because of the great savings in . . .*

**. . . the total amount of material involved in the breakwater, the amount of concrete used handling equipment.**

SOTRAMER

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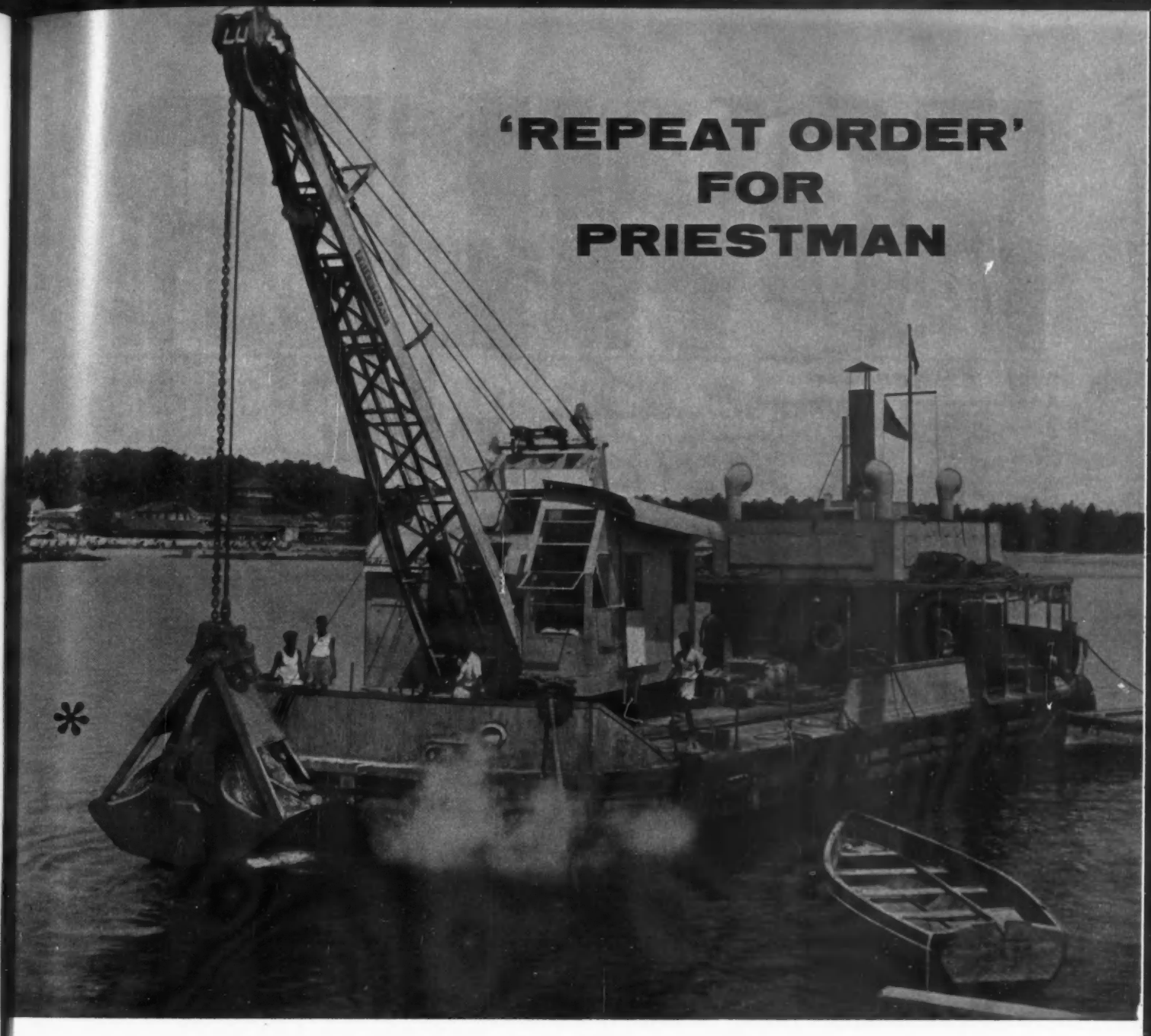


## ...with a third Grab Dredger for the Colombo Port Commission

*** DREDGER IS SHIFTING 80 TONS OF DENSE SAND IN 20 MINUTES**

Chosen with confidence by Port and Harbour Authorities all over the world; Priestman Grab Dredgers offer, not only efficiency, reliability, and low-cost maintenance; but also a high degree of accuracy.

—And the Priestman System operates in circumstances and conditions impossible to other systems of dredging!

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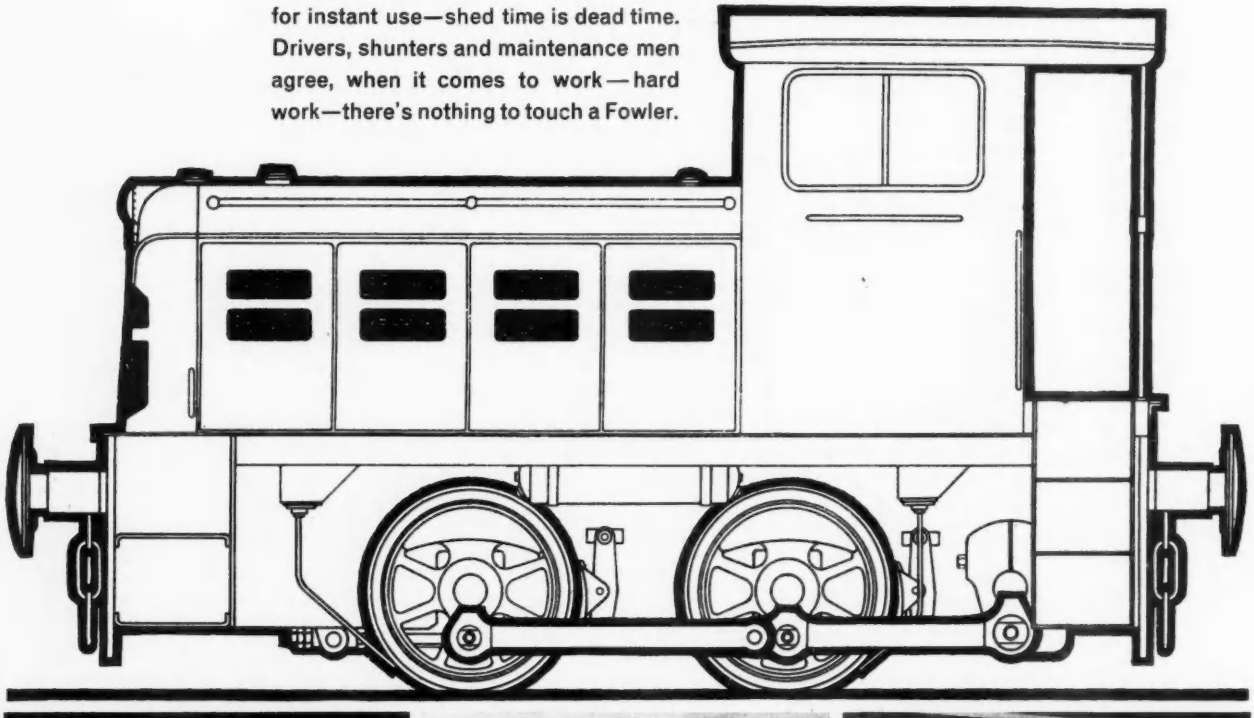
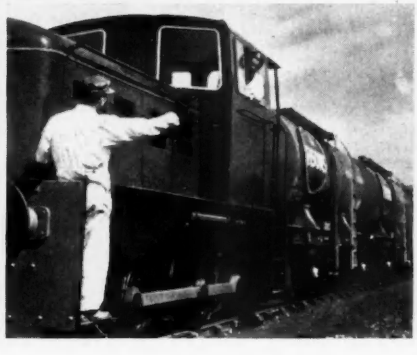
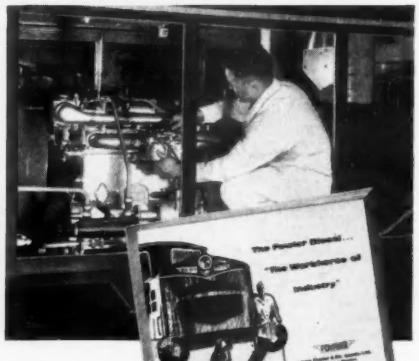
# FOWLER

## MEANS FASTER HANDLING

Everything about a Fowler diesel shunter spells functional efficiency. With finger-tip control and all-round visibility it's simple, and non-tiring to drive. Maintenance requirements are even simpler, that's why this diesel is always ready for instant use—shed time is dead time. Drivers, shunters and maintenance men agree, when it comes to work—hard work—there's nothing to touch a Fowler.







*There is a wide range of Fowler diesels fully described in this new technical leaflet, gladly supplied on request.*

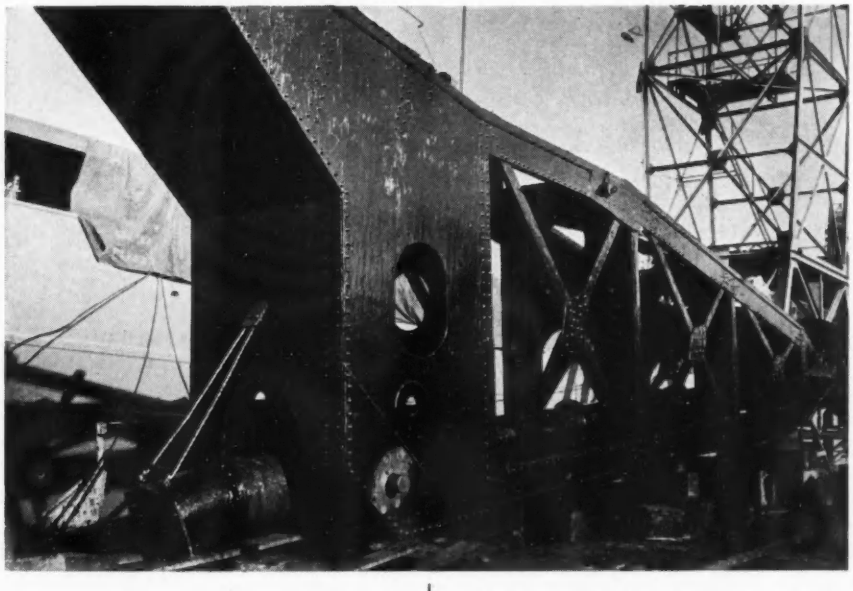
**JOHN FOWLER & COMPANY (LEEDS) LTD, LEEDS 10. TEL: 30731**

NUMBER TWENTY-TWO

# I.H.C. HOLLAND NEWS ITEMS

A BI-MONTHLY BULLETIN ON DEVELOPMENTS IN DREDGING

## EASIER REPAIR OF SUCTION TUBE CONNECTION IN CUTTER SUCTION DREDGERS



In cutter suction dredgers the suction tube carried in the ladder is normally connected to the piping inside the dredger by means of flexible rubber hose, and the carrying out of repairs in its neighbourhood is liable to present difficulties. To meet this problem the connecting joint between the inside and outside pipes is sometimes raised above the waterline of the vessel, but this entails the possibility of an air lock developing in the event of any leakage in the joint.

I.H.C. Holland have evolved a quite simple method whereby the joint can be kept below the waterline when the vessel is operating, but raised above it for inspection of repair. This is done by providing an extra point of support on the ladder, consisting in the main of two holes through which a loose shaft can be inserted a few inches abaft the centre of gravity of the ladder. To raise the rubber hose connection for access the cutter ladder is hoisted so that the two holes appear above deck level; then the loose shaft is inserted so that its ends are supported on the reinforced edges of the ladder well, which are fitted with guide bushes for the ladder shaft and for the flange of the extra pipe section with which the suction tube is provided.

It will be obvious that when carried on this shaft the entire ladder can be tilted by its own weight. The rubber hose connection which is situated between the suction tube proper and the extra pipe section with flange is raised to an accessible position above the waterline. This permits repairs or replacements to be carried out quickly, reducing idle time and the cost of the work to a minimum.

### DID YOU KNOW?

The Port Authorities of Huelva, Spain, have entrusted I.H.C. Holland with the construction of a medium large trailing suction hopper dredger. The vessel is to be delivered within twelve months.
The main dimensions are 238′ x 44′ x 19′ 6″.
Hopper capacity: 53,000 cu. ft.

*

The bucket dredger " Kyant-Khaing-Yay " destined to Rangoon was launched on January 11, 1960. This dredger was procured with a World Bank loan and will be a welcome addition to the Burmese dredging fleet.
Delivery will take place in August 1960.

*

" Vikas " is the name of a grab hopper dredger recently delivered to the Bombay Port Trust. This dredger is fitted with four grab cranes and a hopper of 28,500 cu. ft. (800 $m^3$) carrying capacity.

*

Of the two giant tugs under construction for the U.A.R.'s Suez Canal Authority the first one, " Mared " is nearing completion. The second, " Shahm," has been recently launched.

*

The cutter suction dredger " Nueve " for an Italian buyer is nearing completion. With its 6500 h.p. " Nueve " will be one of the strongest dredgers in the world.

*

ELECTRIC DRIVES ON DREDGERS is the title of the first volume in I.H.C. Holland's new Series of Reprints. A limited number of copies is still available for professionally interested people. If you write for a copy please use business letterhead paper.

D.13

**To I.H.C. HOLLAND**
Shipbuilders and engineers
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*Please send full list of descriptive literature*

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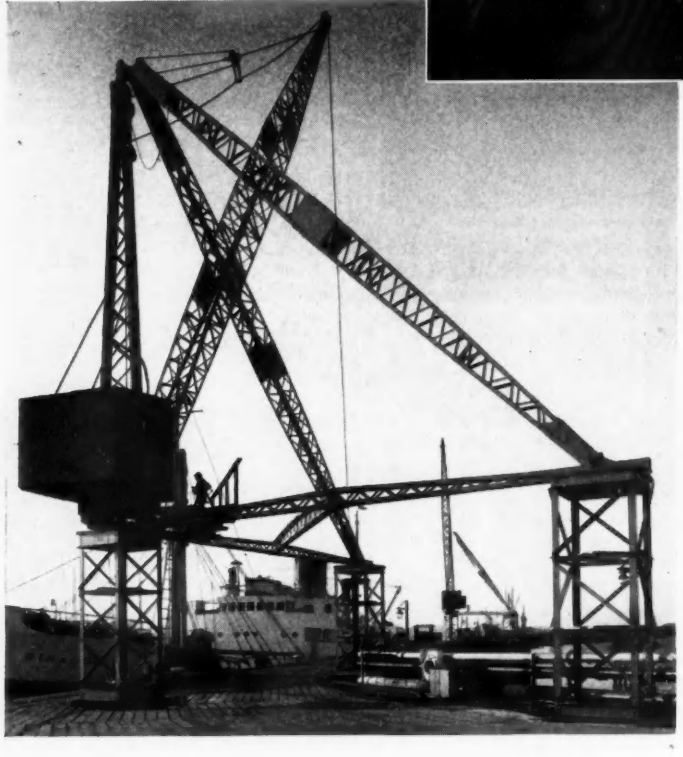
Firm _____
Street _____
Town _____

# VIEW OF LONDON GRAVING DOCK

*as seen by the operator of a*

# SPECIAL BUTTERS DERRICK



The unusual feature of this crane is that, despite its appearance, it is steam driven. Steam available on the spot is piped into the crane to provide the motive power giving a very economical set up.

For simplicity, efficiency, economy and easy maintenance the BUTTERS DERRICK is the answer : full details are available on request. Or call to see us in Glasgow when we will be happy to show you design and manufacture in progress in our specialised works.

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## PAINTS THAT STAY NEW LONGER

PICKLING SHOP *at Appleby-Frodingham Steel Company, Scunthorpe Lincs. painted with Evodyne over Evoled*
*Photograph by courtesy of Appleby-Frodingham Steel Company (Branch of the United Steel Companies Limited)*

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the ideal combination for Acidic conditions is . . .

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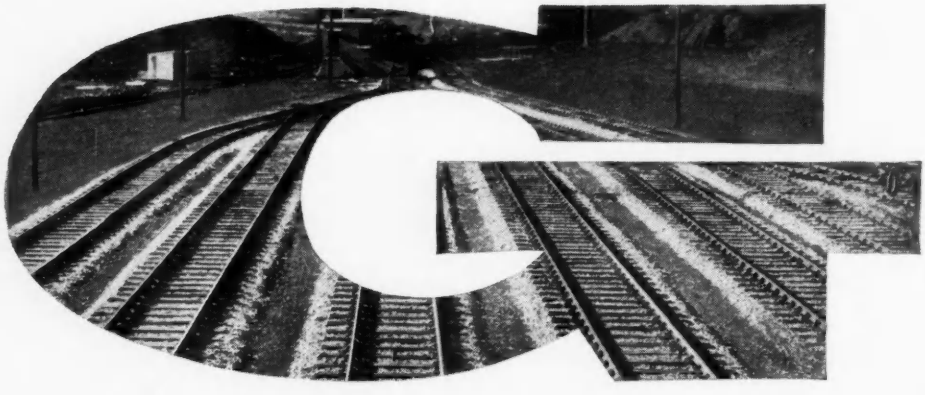
N-W.177

THEY MUST BE WELL MADE



TO BE WELL LAID

The resources of R & G are vast and various — from design to manufacture. These resources are matched by the experience and skill of the R & G organisation. You will find in many lands R & G installations varying from small underground layouts to complicated systems above ground.

If you need any form of railway trackwork, get in touch with R & G. Their experience and their resources are your surety of satisfaction.

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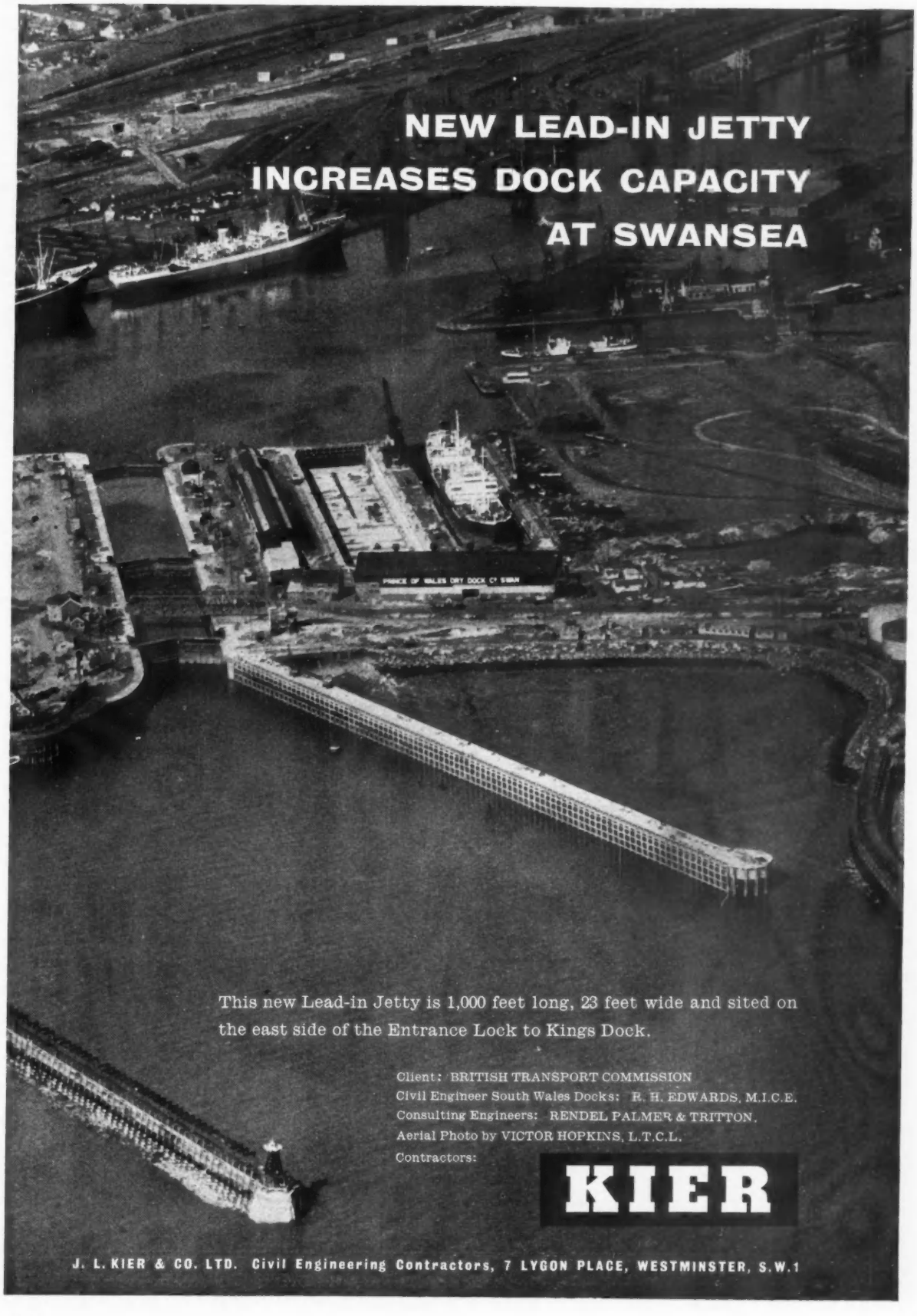
NEW LEAD-IN JETTY
INCREASES DOCK CAPACITY
AT SWANSEA
This new Lead-in Jetty is 1,000 feet long, 23 feet wide and sited on the east side of the Entrance Lock to Kings Dock.
Client: BRITISH TRANSPORT COMMISSION
Civil Engineer South Wales Docks: R. H. EDWARDS, M.I.C.E.
Consulting Engineers: RENDEL PALMER & TRITTON.
Aerial Photo by VICTOR HOPKINS, L.T.C.L.
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Dockside Cranes bearing the name of "Smith", of Rodley, are familiar sights in the ports of the world. Made in various sizes to suit site conditions or the special requirements of the purchaser, they are of the most modern design structurally, mechanically and electrically. More and more of them are being installed at home and abroad, for the very good reason that their reliability and efficiency has been proved beyond question.

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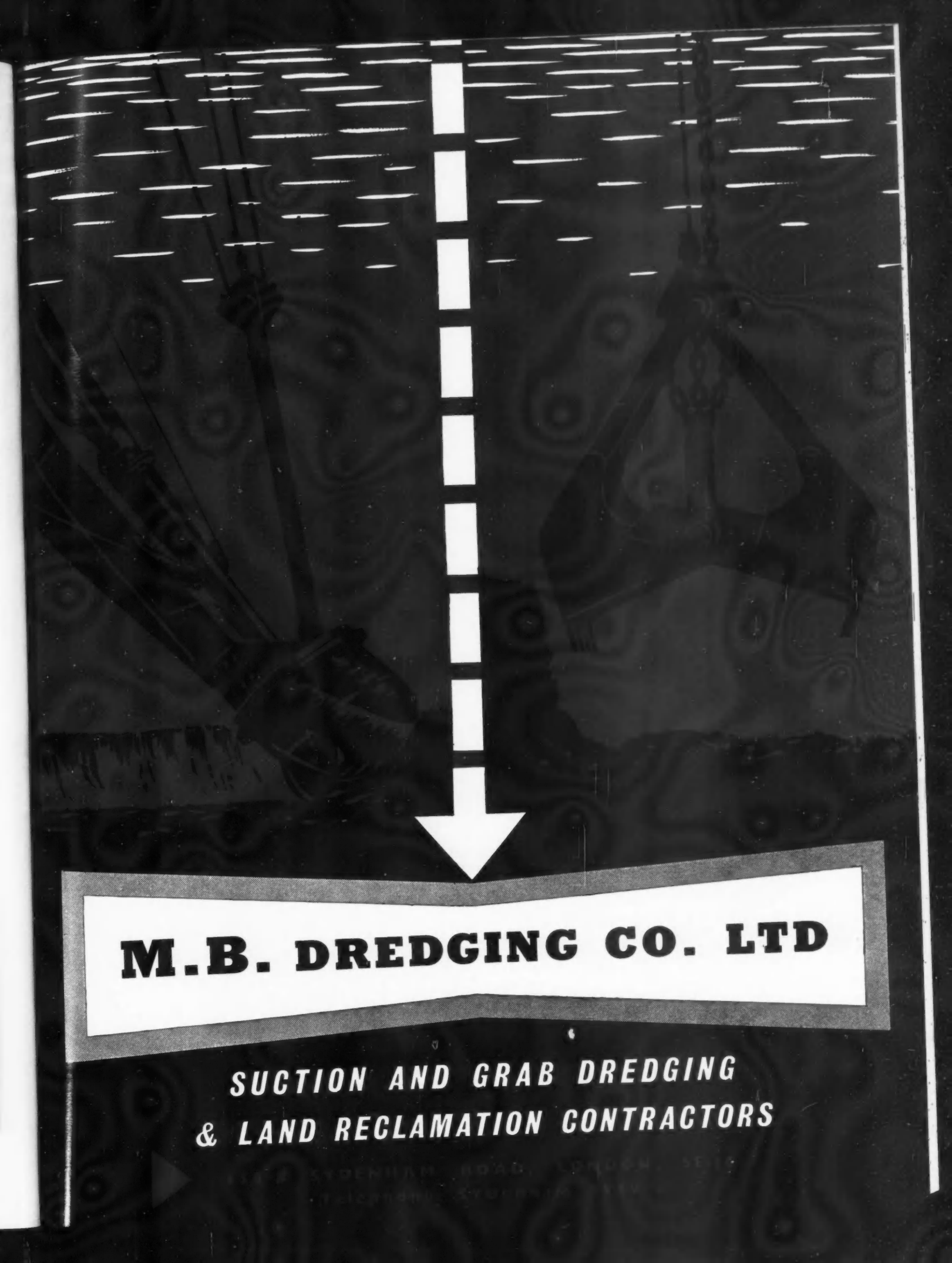
SMITH 5-TON CAPACITY LEVEL-LUFFING CRANE supplied to Fords of Dagenham.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Each of the machines can be engaged or disengaged as required and they are provided with individual gear boxes so that speeds may be changed independent of each other. Three machines can be operated simultaneously when necessary. These can be Lathe, Shaper and Drill or Lathe, Miller and Drill.

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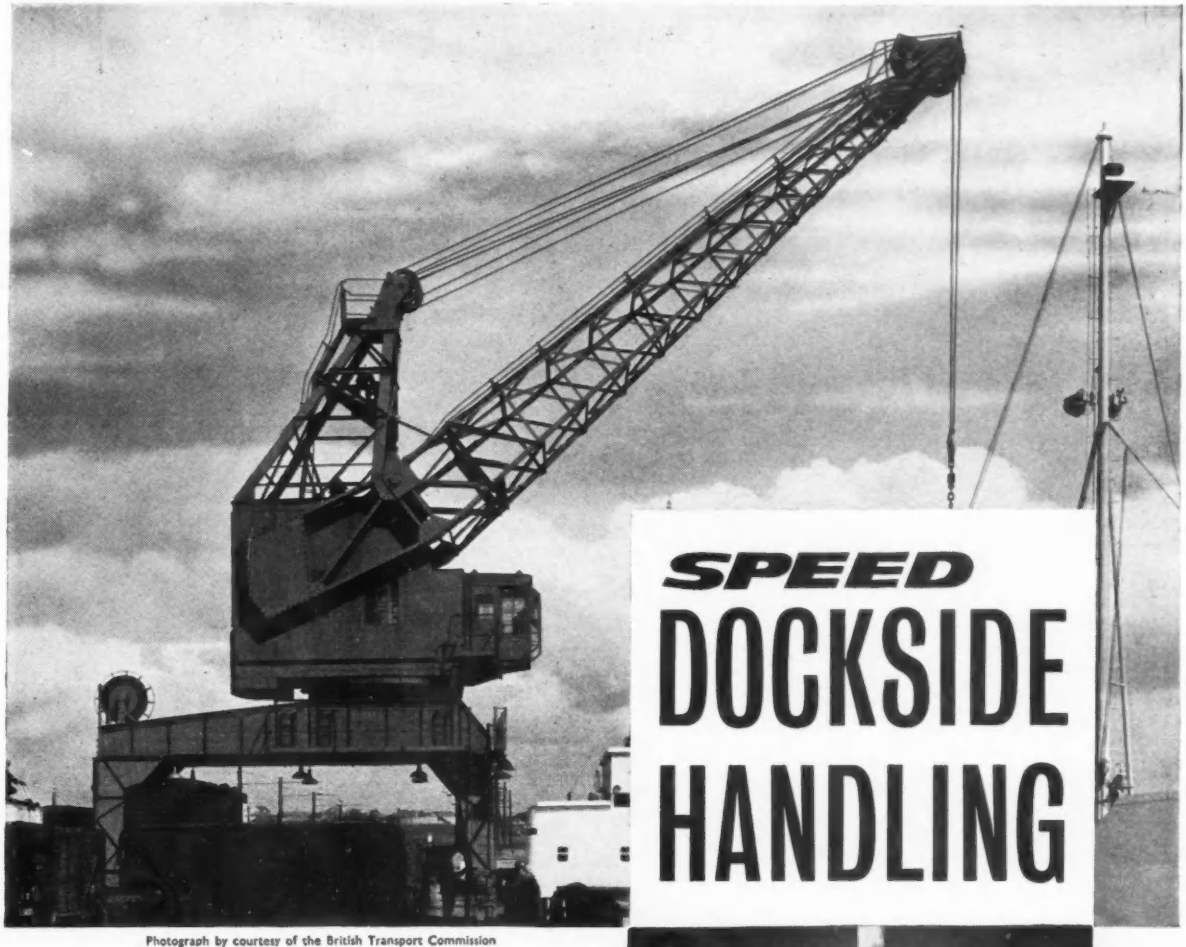
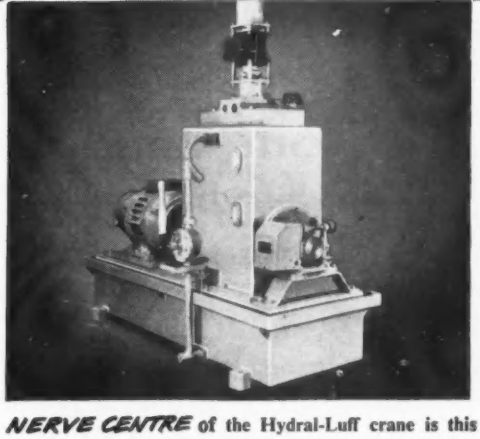


Photograph by courtesy of the British Transport Commission

# SPEED DOCKSIDE HANDLING

## WITH THE CLYDE (Patent) HYDRAL-LUFF

**The Clyde Hydral-Luff Crane is an electric crane but the jib is operated from the luffing motor by means of a hydraulic cylinder and transmission system. It has established a new standard of smooth operation and speed for many companies engaged on dockside handling. The electro-hydraulic system simplifies the luffing motion, requiring less moving parts and maintenance. These factors combined with the speed, capacity and other features of Clyde Dockside Cranes could well reduce your handling costs. Please write for our new Hydral-Luff brochure HL/1/59 or ask us to arrange a demonstration.**



***NERVE CENTRE*** **of the Hydral-Luff crane is this electric luffing motor and hydraulic system, compactly arranged and accessibly mounted.**

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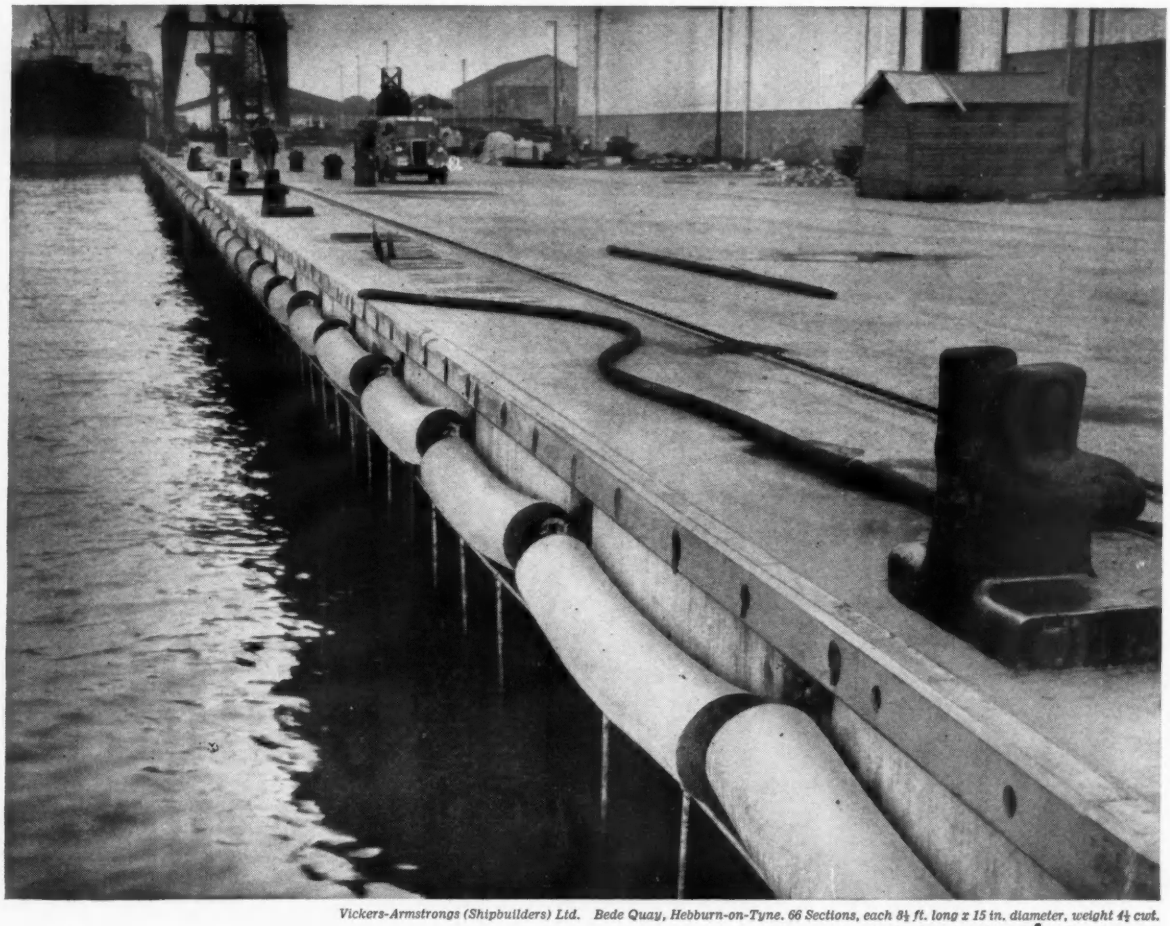

*Vickers-Armstrongs (Shipbuilders) Ltd. Bede Quay, Hebburn-on-Tyne. 66 Sections, each 8½ ft. long x 15 in. diameter, weight 4¼ cwt.*
*Contractors: Marples Ridgway & Partners Ltd.*
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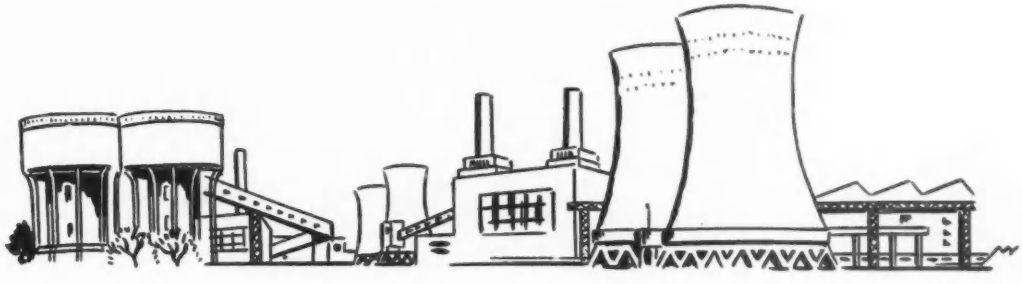

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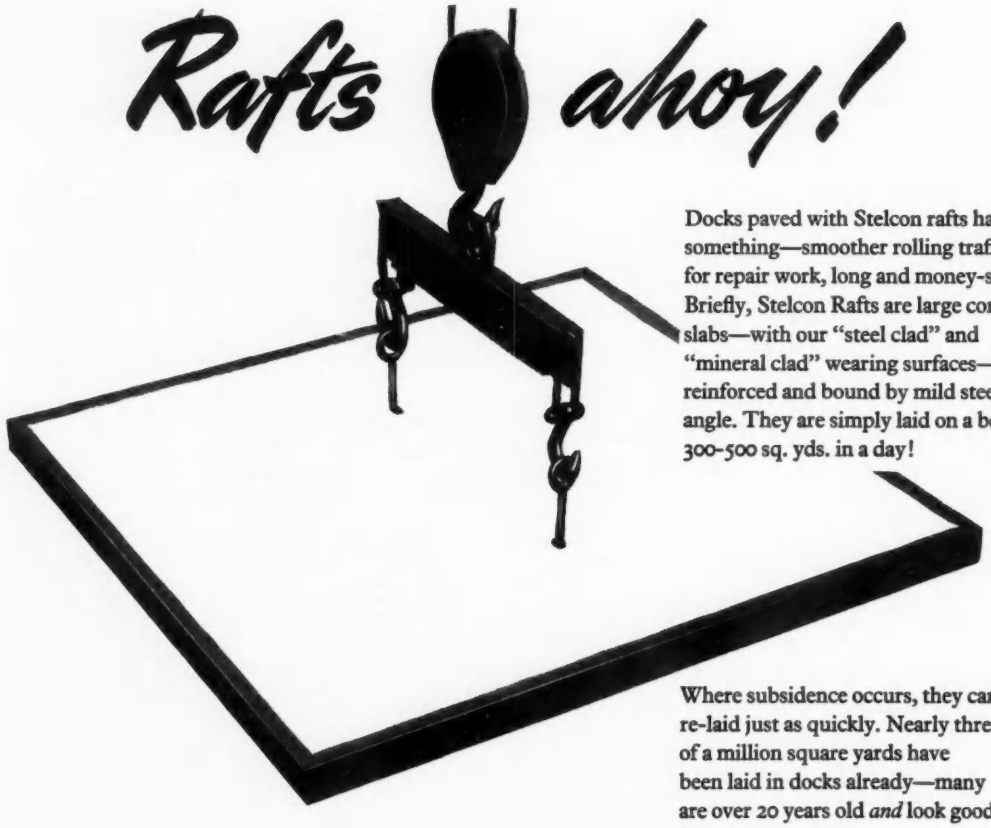
# Rafts ahoy!



Docks paved with Stelcon rafts have got something—smoother rolling traffic, no hold-ups for repair work, long and money-saving life. Briefly, Stelcon Rafts are large concrete slabs—with our "steel clad" and "mineral clad" wearing surfaces—doubly reinforced and bound by mild steel angle. They are simply laid on a bed of sand, 300-500 sq. yds. in a day!

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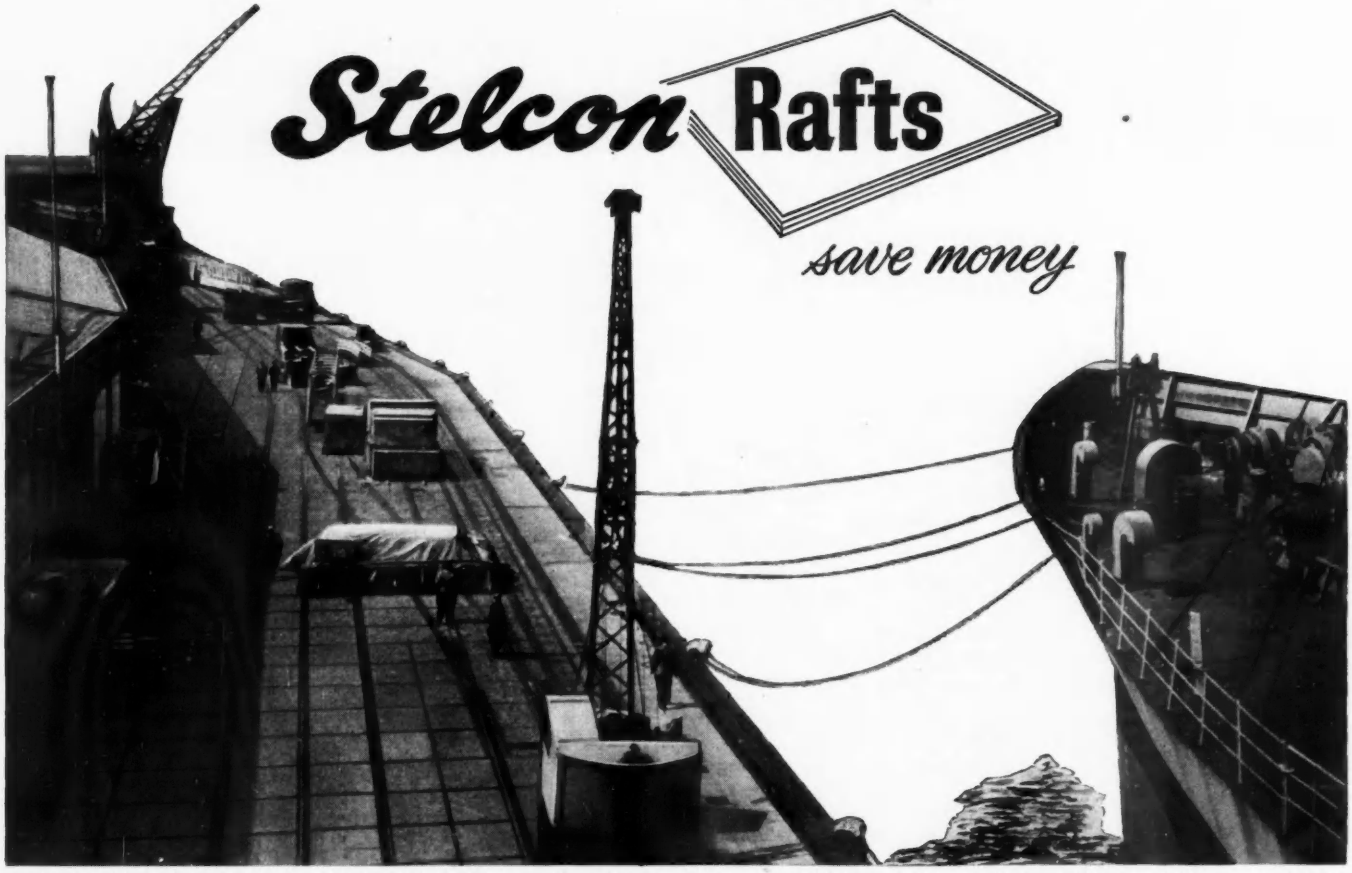
## Stelcon Rafts

*save money*



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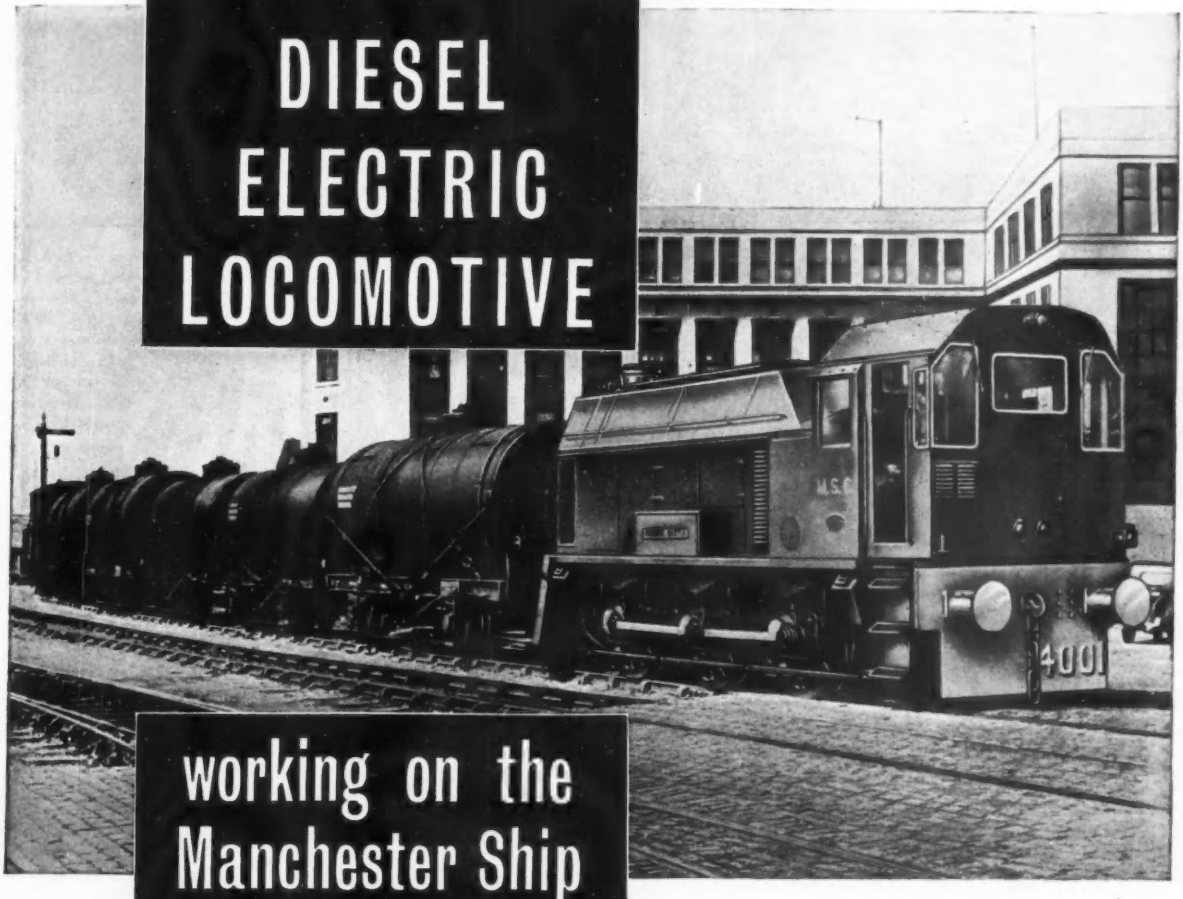
# 400 B·H·P DIESEL ELECTRIC LOCOMOTIVE

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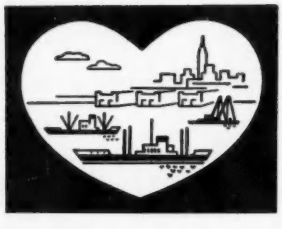

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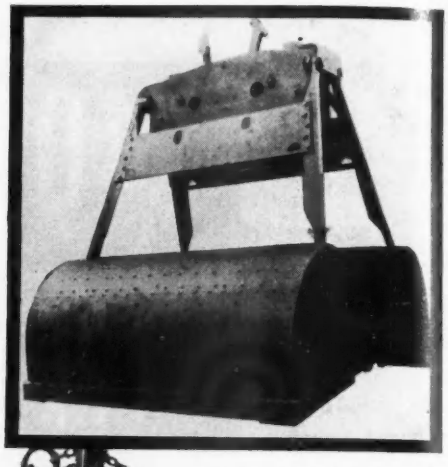

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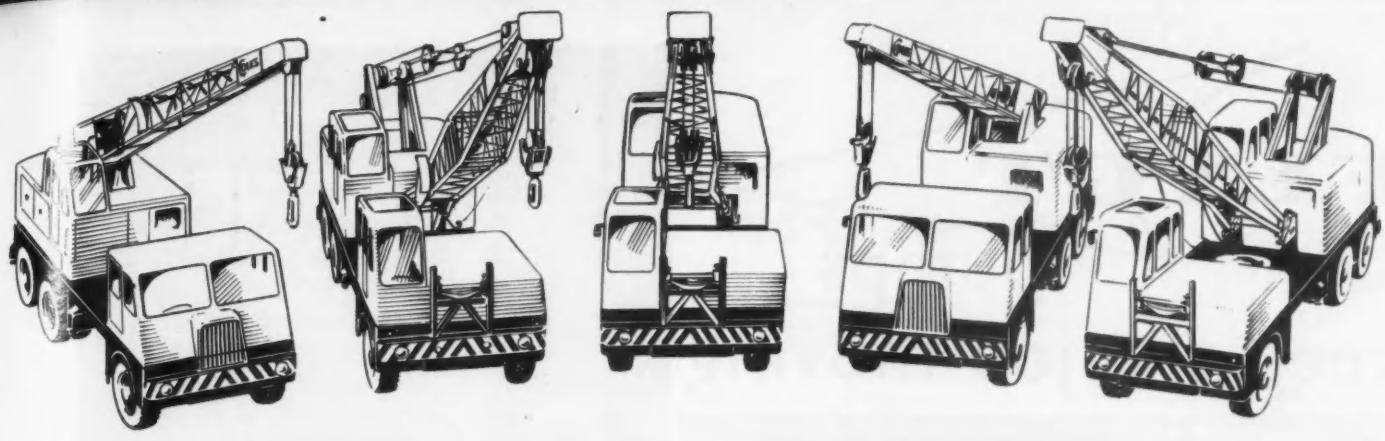
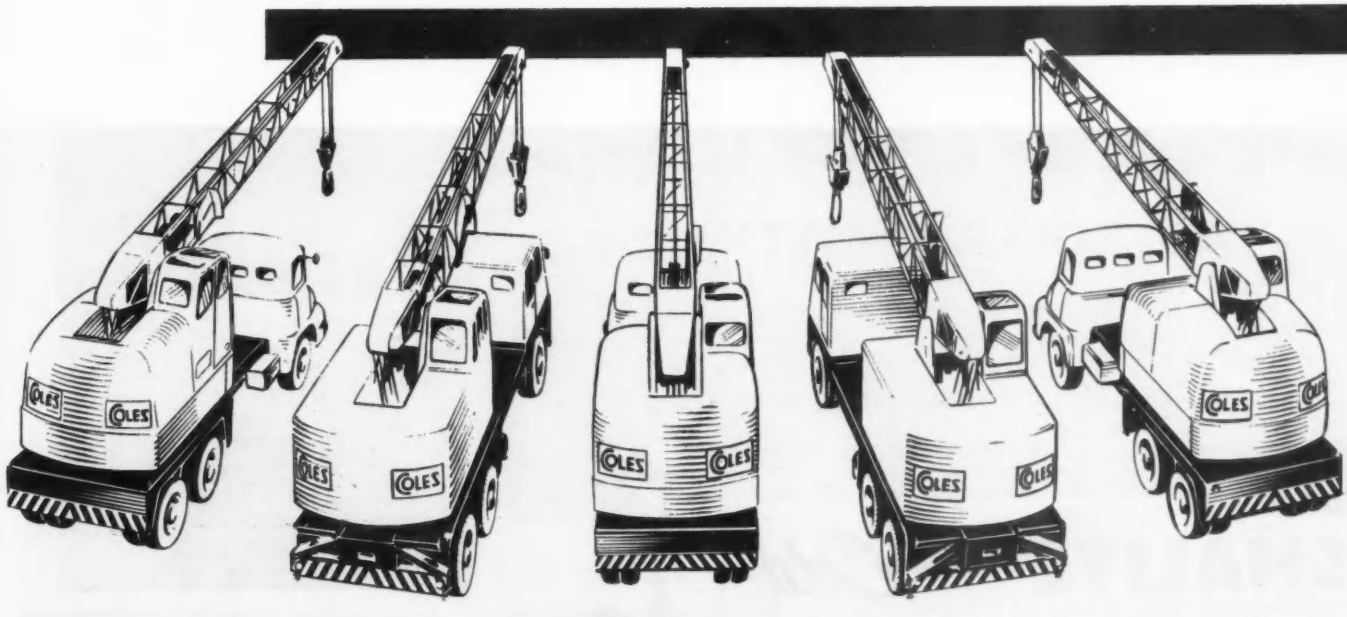


# Wood, Pritchett & Partners Ltd., order another ten Coles Diesel-Electric Truck Mounted Cranes for their new depot




This new Depot opens in MAY. It is on A2–1½ miles on the London side of Dartford. Wood, Pritchett & Partners Ltd., are determined to enhance and maintain the excellent reputation of their MECHQUIP hire fleet by using the best machines available on the market.

COLES CRANES
REGISTERED TRADE MARK

THE NAME THAT CARRIES WEIGHT

*Designed, manufactured and marketed by:—*
**STEELS ENGINEERING PRODUCTS LIMITED, Sunderland, England**
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A FLYGT Pump working unattended overnight kept this site dry, thus enabling the men to commence work immediately on arrival in the morning without loss of time. The contract was consequently completed ahead of schedule with a corresponding reduction in cost and increase in profit. The FLYGT Pump was simply lowered into the water, coupled up and left working unattended for days on end.

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# Sea Defences

## AT SOUTHPORT

**. . . at Southport, the sea wall was grouted with ESHALITE, with great success. The illustrations show the construction of these defences which have already withstood heavy battering without any ill effects**

**CHOOSE**

**ESHALITE** APPLIED *Cold*

**for random or placed stone revetments. or for sea and river defence works**

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***1. A sandbank is formed at the front of the sea wall and this is faced on the seaward side with bitumen-stabilized sand, on which stone setts are laid.***

***2. The stone setts are grouted with Eshalite applied cold—providing the essential features and advantages of both concrete and asphalt, without the disadvantages of either.***

***This narrow sandbank is then backed up with selected refuse and rubble to form the full width of the sea embankment.***

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***IT'S A DUSSEK PRODUCT***

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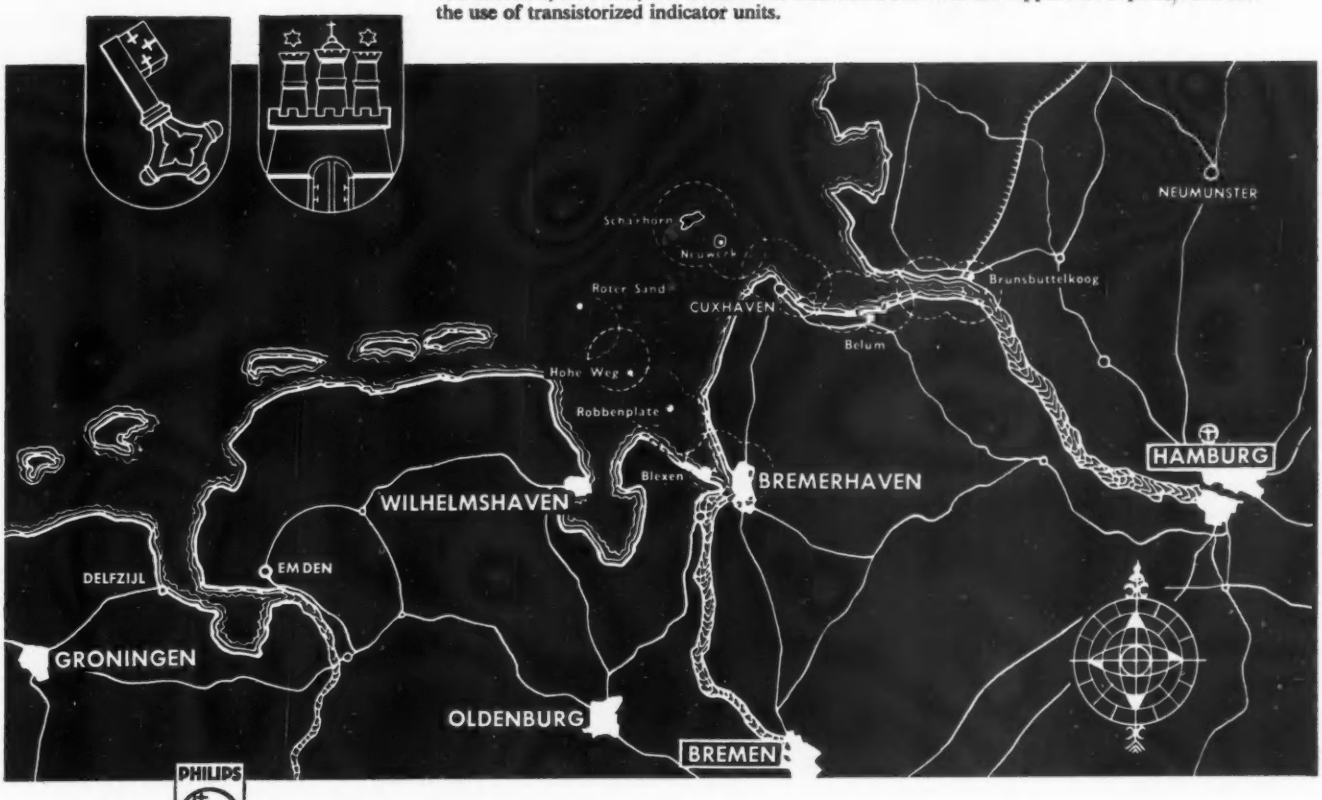
# RADAR

## *brings new efficiency to famous sea-lanes*

**Amsterdam** can boast the first permanent port radar installation to be set up on the continent of Europe. Philips supplied the necessary equipment, which went into service in November, 1952.

**Rotterdam** can point with pride to the world's first chain of civil radar stations. These, seven in number, were also fitted with Philips port radar equipment, adapted to the special navigational requirements of the New Waterway. That was in 1956.

The **Elbe-Weser** contract, awarded to Elektro Spezial, covers a total of eight waterday radar stations, four at the mouth of the Elbe and four on the estuary of the Weser, some of which have to be installed in lighthouses. The equipment for this project will be supplied by Philips. The radar pictures obtained by the stations, some of which are unmanned, are transmitted to central stations (one on the Weser and two on the Elbe). A complete picture of shipping in the waterways covered is thus available in the central stations. In developing and designing the equipment for this project, particular care was devoted to ensuring reliable performance, and this accounts, inter alia, for the fact that transmitter receivers are supplied in duplicate and for the use of transistorized indicator units.




**Philips'** experience in engineering and manufacturing port and waterway radar equipment fully adapted to local conditions is unequalled by that of any other firm. Extreme precision, exhaustive experiment, progressive design and the application of the most modern techniques are some of the marks by which Philips radar equipment is known - the equipment with which Philips is bringing new efficiency to famous sea-lanes.

*40 Years' experience in the field of telecommunication*

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The Port of Long Beach, California

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along with all types of tugs, reclamation barges, sea-going hopper barges, etc., go to make up the great dredging fleet of our Organization — an Organization which has been entrusted with the dredging involved in the construction of the new Europoort at the mouth of the New Waterway opposite the Hook of Holland, This latter project involves 45,000,000 cubic yards of dredging and reclamation to be completed within a period of 24 months.

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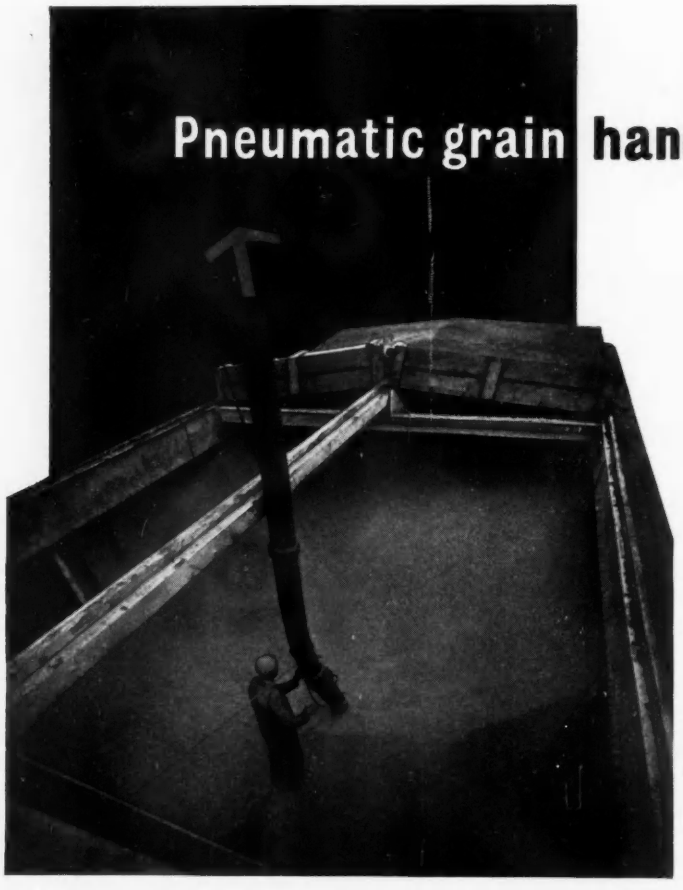

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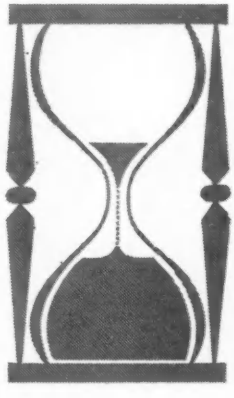
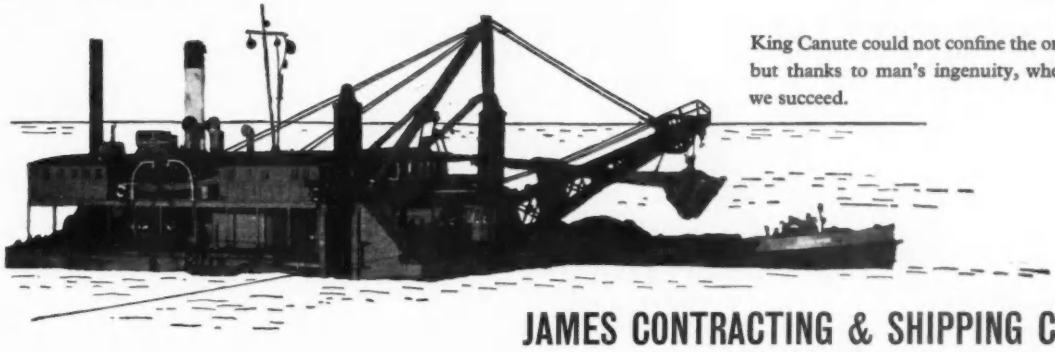
*Canute reproving his courtiers at Southampton, from a painting by Lorentz Frolich.*

# "Nae Man can tether Time or Tide"

The poet's words are as true today as they ever were, man still pits himself in endless war against the sea. Man cannot relax in this struggle — though he sleeps the sea never rests — the tide rips ceaselessly at the sea wall — rivers carry their burden of silt to the estuaries, — winter winds and tides bring mountainous seas that flood the land, and leave desolation in their wake. To tether the tides and tame the sea — reclaim the land and keep harbours and channels clear, potent tools are needed — we can provide these tools — together with the skills gained during many years of unremitting war against the sea in all parts of the world.





King Canute could not confine the oncoming tide, but thanks to man's ingenuity, where he failed, we succeed.

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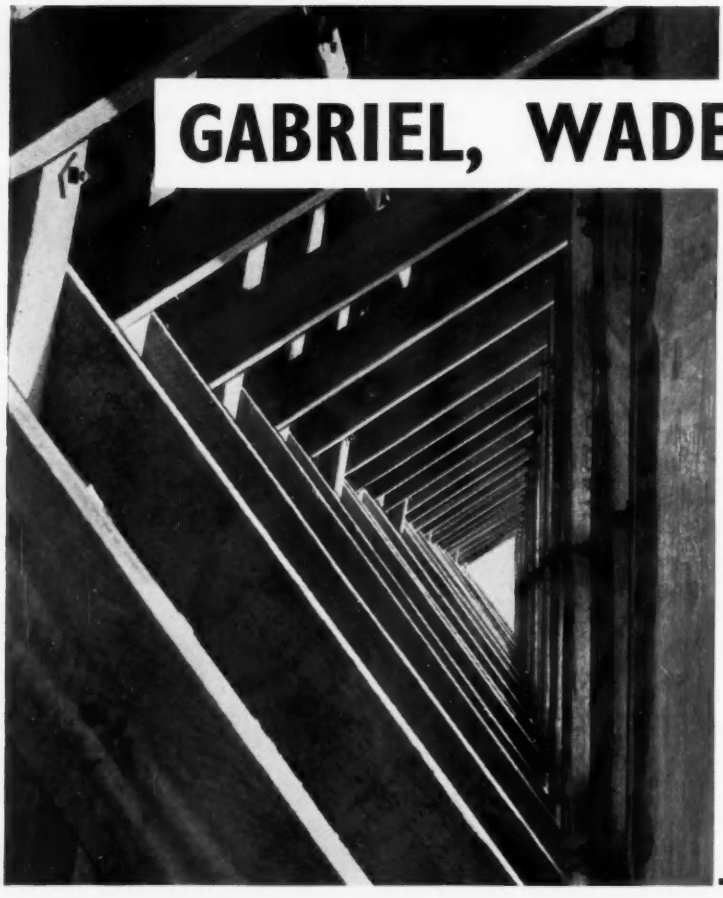

*Sharpness Docks, Gloucester.*
*Photograph by permission of British Transport Waterways*

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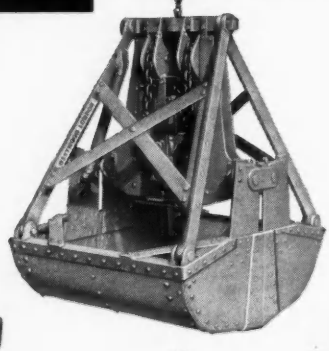
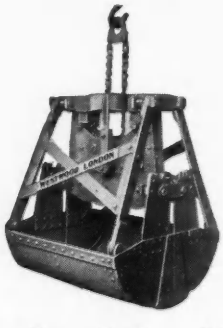
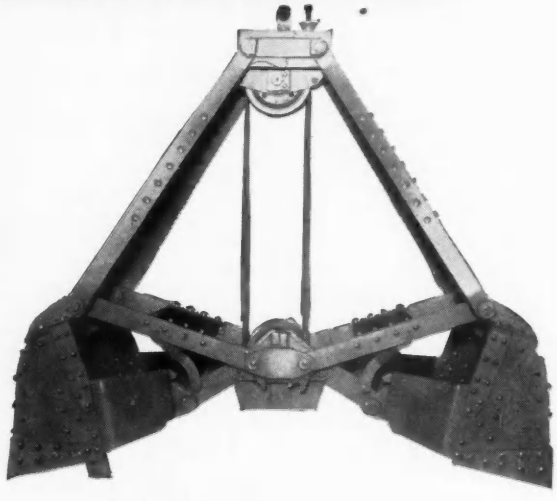
# WESTWOODs MECHANICAL GRABS

*Above:*
Double Rope Grab of Heavy construction. Lever arm design gives increased closing power.

*Right:*
Twin Chain, Self Dumping grab which is particularly suitable for handling coal and similar materials where headroom is restricted.







*Above:*
Superspan Grab, without teeth, designed to give increased efficiency when handling difficult materials. Also used for cleaning up railway wagons, ships' holds, etc. Ref 341.

*Top left:*
Single Chain, Self Dumping grab which is particularly suitable for handling coal, sand, ballast, etc.

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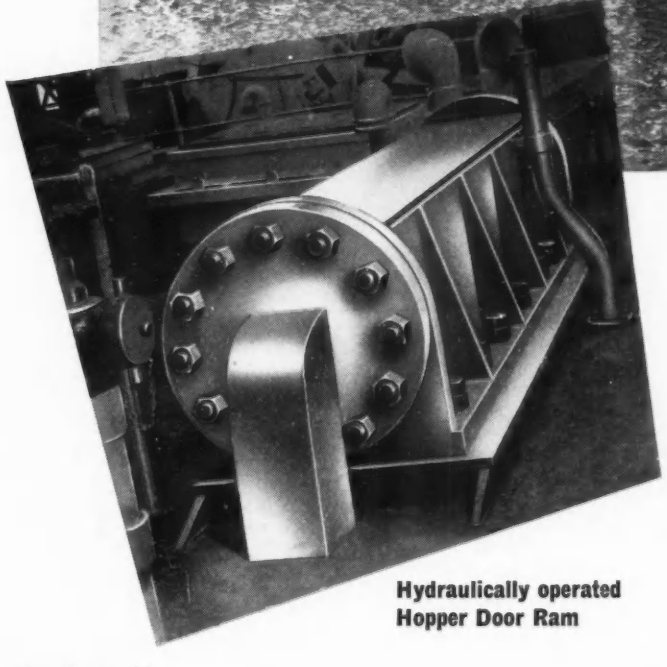
*The Diesel Hopper Dredger* **'KENFIG'** *built by Richard Dunston Ltd. at their Hessle Shipyard.*



**Hydraulically operated Hopper Door Ram**

The Diesel Hopper Dredger 'KENFIG' is one of four such craft belonging to the British Transport Commission.

All four vessels are fitted with one pair of hydraulically operated Hopper Door Rams, designed and manufactured by VICKERS-ARMSTRONGS LTD., each giving a 90-ton pull with a 6 ft. 9 in. stroke. Two of the vessels are equipped with Vickers-Armstrongs steering gear.

*Manufactured by*

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**for efficient crossing and entrance control**

Left—An installation of a pair of Bolton Traffic Barriers at a factory entrance, controlled from the lodge. The Commissionaire Unit for the control of swing gates, shown below, is self-contained and is also remote controlled.

*Write for literature on Bolton Traffic Barriers and Gate Control Units, reference DH357*

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BG 357

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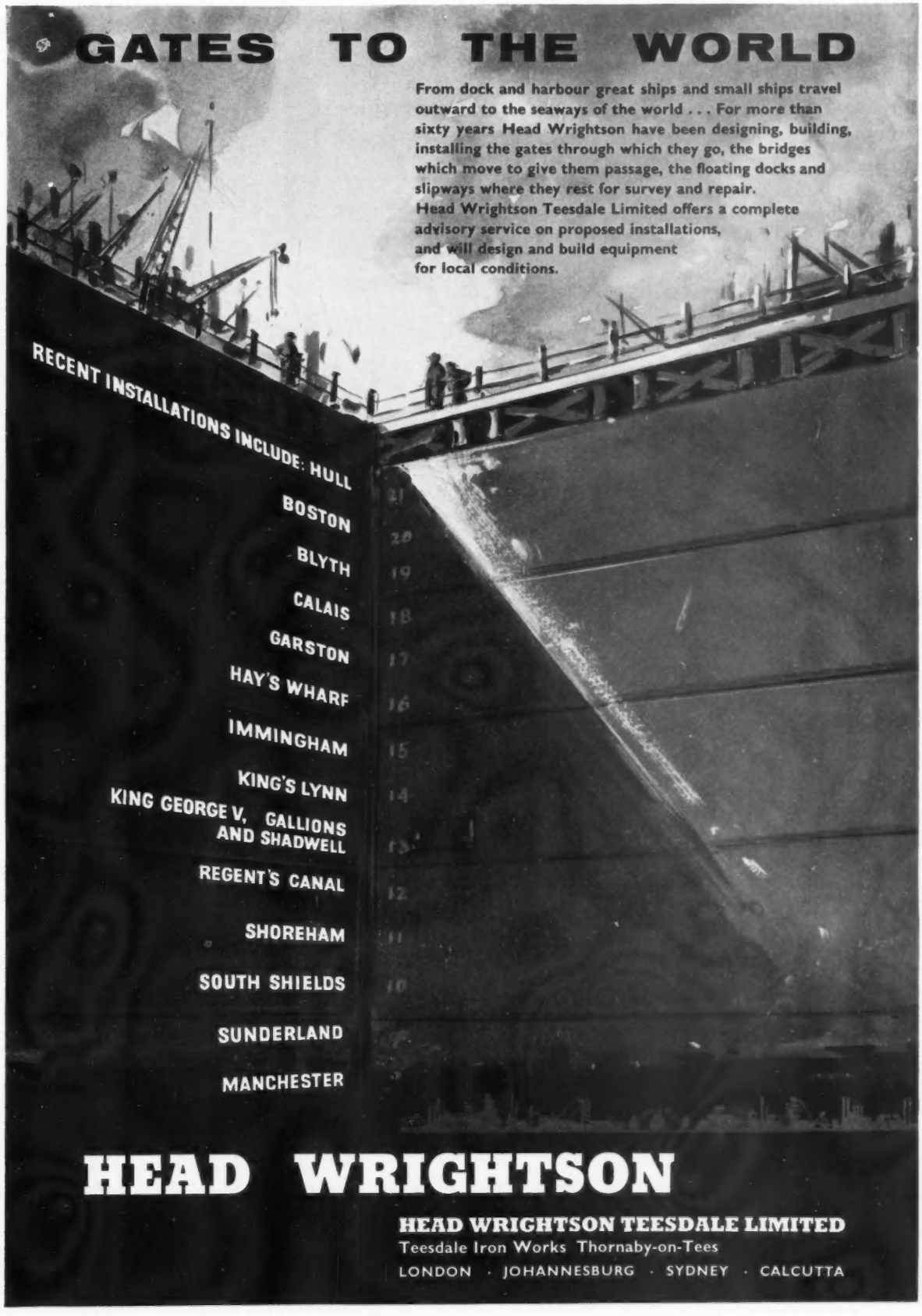
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*Photo by courtesy of J. P. Harvey & Co. Ltd., Kidderminster*

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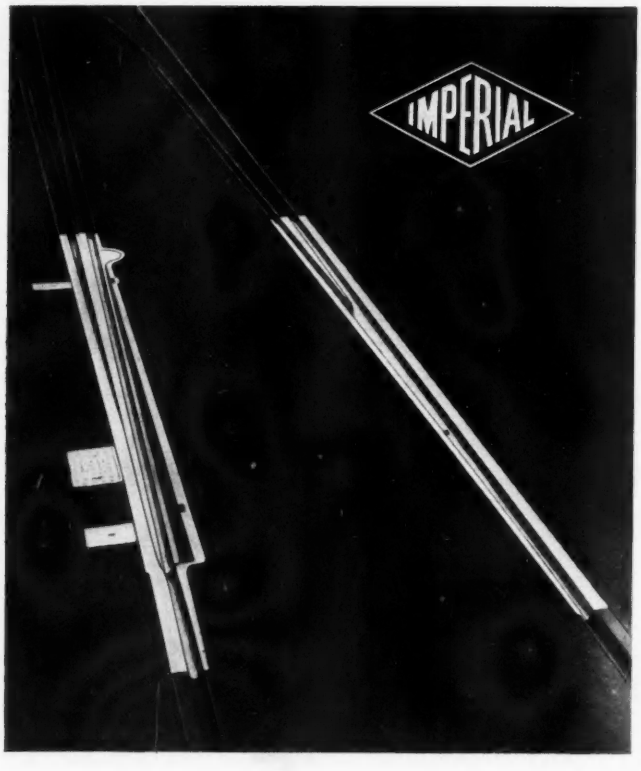


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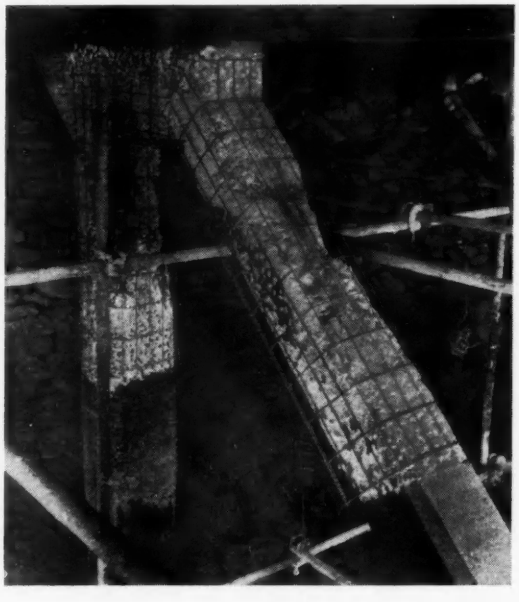

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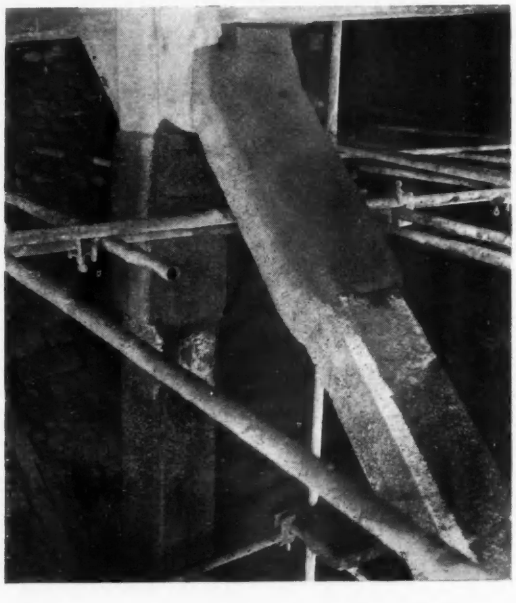

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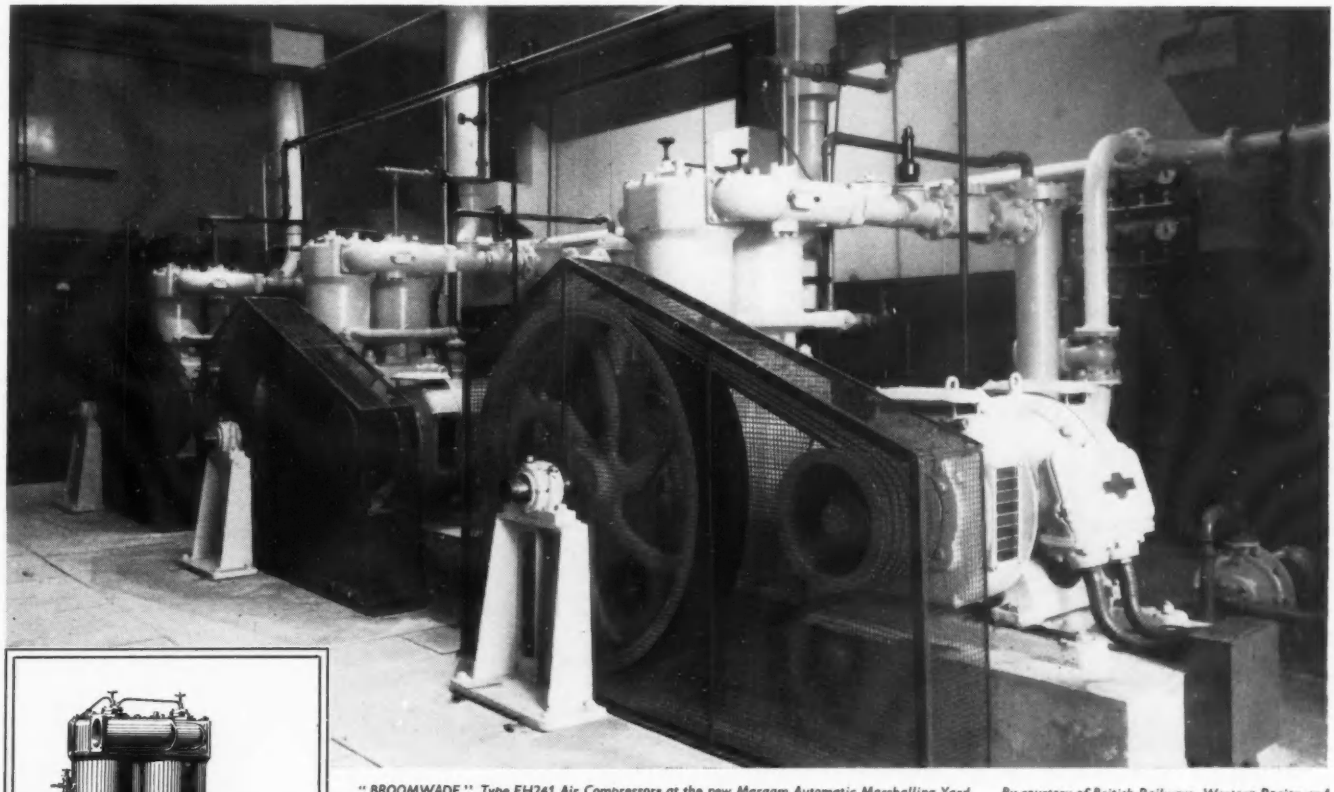
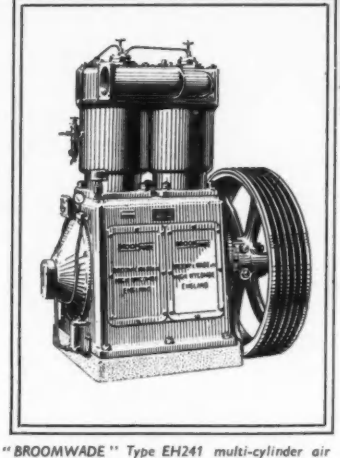


*"BROOMWADE" Type EH241 Air Compressors at the new Margam Automatic Marshalling Yard. By courtesy of British Railways, Western Region and Associated Electrical Industries-GRS Ltd.*



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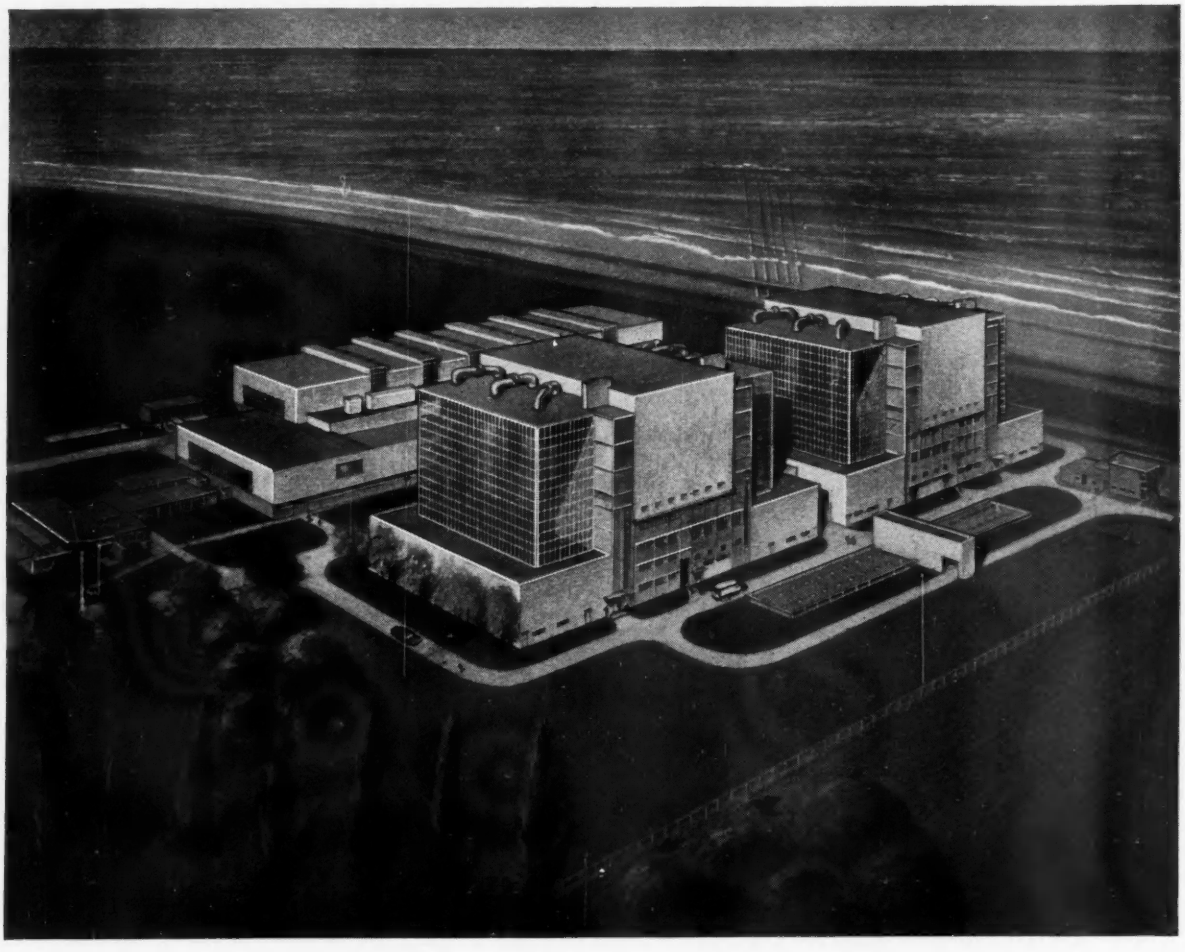

# Bradwell Nuclear Power Station

This illustration is an artist's impression of the Bradwell Nuclear Power Station, which is to supply electricity to the National Grid. All hydrographic survey work in connection with this project was carried out by Kelvin Hughes on behalf of the Consulting Engineers: Messrs. Rendel, Palmer & Tritton, acting for the Central Electricity Authority.

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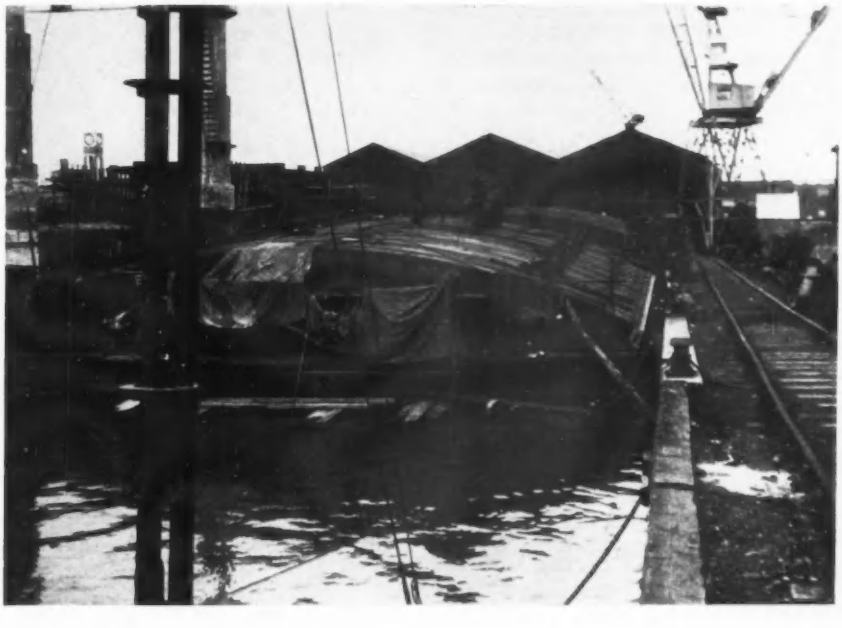
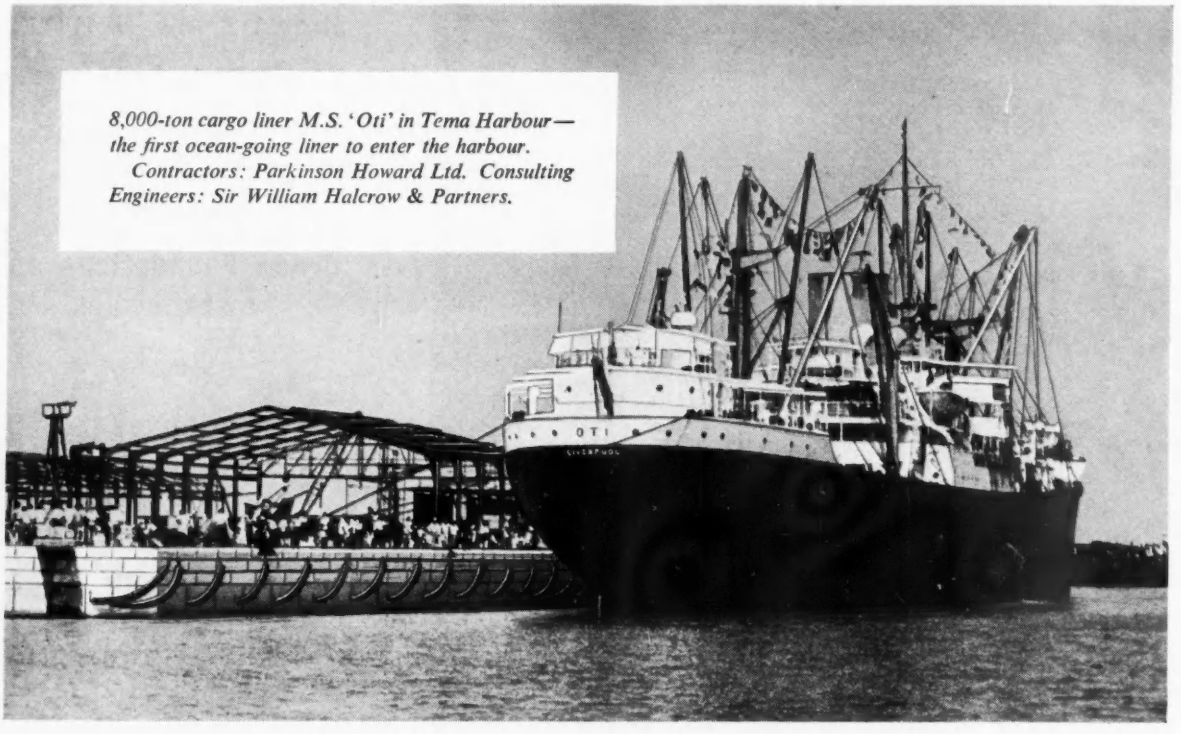


**400-ton Gates hauled up in Messrs. Chas. Hill's Dockyard, Bristol**




*8,000-ton cargo liner M.S. 'Oti' in Tema Harbour—the first ocean-going liner to enter the harbour.*
*Contractors: Parkinson Howard Ltd. Consulting Engineers: Sir William Halcrow & Partners.*

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Now in use in over 70 countries, Goodyear Dock Fenders resist abrasion, cutting, corrosion and decay. They are first choice where high energy absorption with minimum maintenance is required.

*"S/T 'Mensah Sarbah', one of two tugs built by Ferguson Bros. (Port Glasgow) Ltd. for ship towing service in the new harbour. Cylindrical Goodyear Fenders 15" x 7½" are fitted to the bow."*

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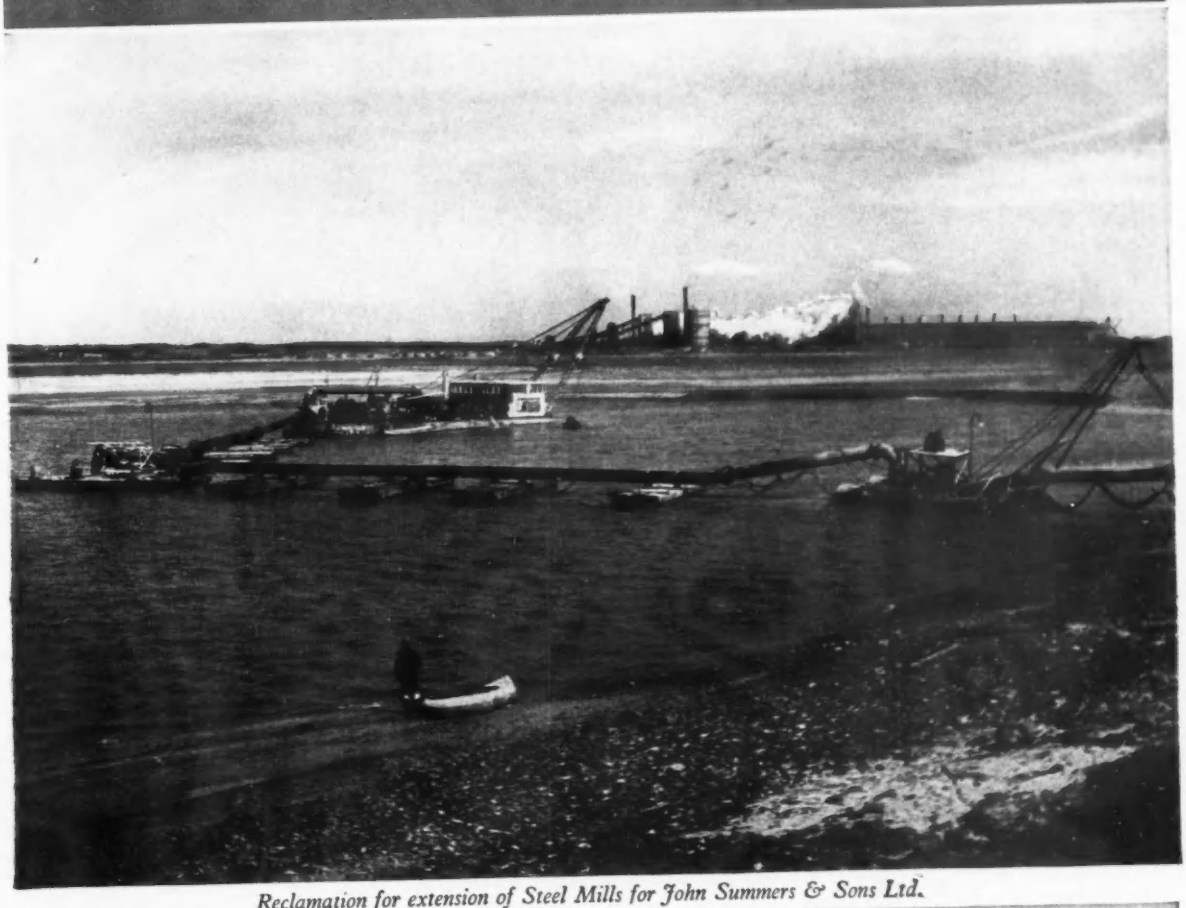
*The Organisation with 3 Centuries of Dredging Experience*



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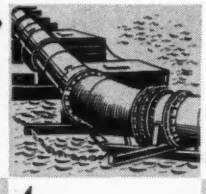
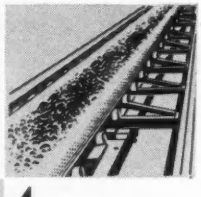
A view of the Velser Tunnel structure under the North Sea Canal.
Contractors: Amsterdamsche Ballast Maatschappij

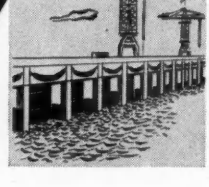
**Vredestein have 50 years' experience and offer 15,000 high-quality products.**



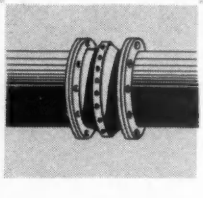
*Dredging sleeves for suction and discharge and various other industrial rubber products for hydro engineering.*



*Various types of smooth and profiled belting for coal, iron-ore, etc.*



*Dock fenders in various designs, including cylindrical and rectangular types for the protection of dock walls, wharves and jetties.*



*Expansion joints to take up the expansion in pipe lines.*

*For further particulars and more detailed information, please apply to*

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## Smaller, Lighter, more Powerful

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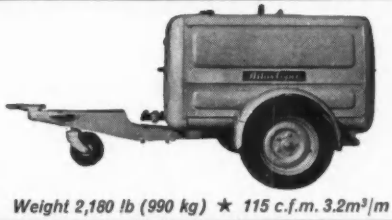
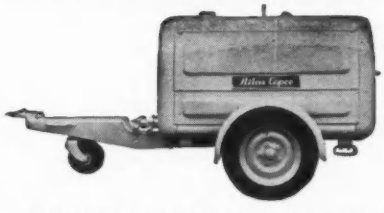
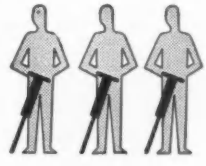


*Weight 2,180 lb (990 kg) ★ 115 c.f.m. 3.2m³/m*

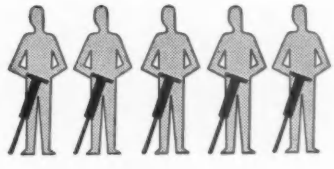
**VT4**





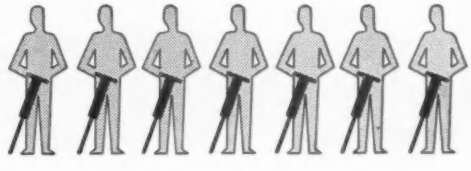
*Weight 2,310 lb (1,050 kg) ★ 160 c.f.m. 4.5m³/m*

**VT5**



*Weight 2,900 lb (1,315 kg) ★ 225 c.f.m. 6.4m³/m*

**VT6**



*Weight 3,590 lb (1,630 kg) ★ 315 c.f.m. 8.9m³/m*

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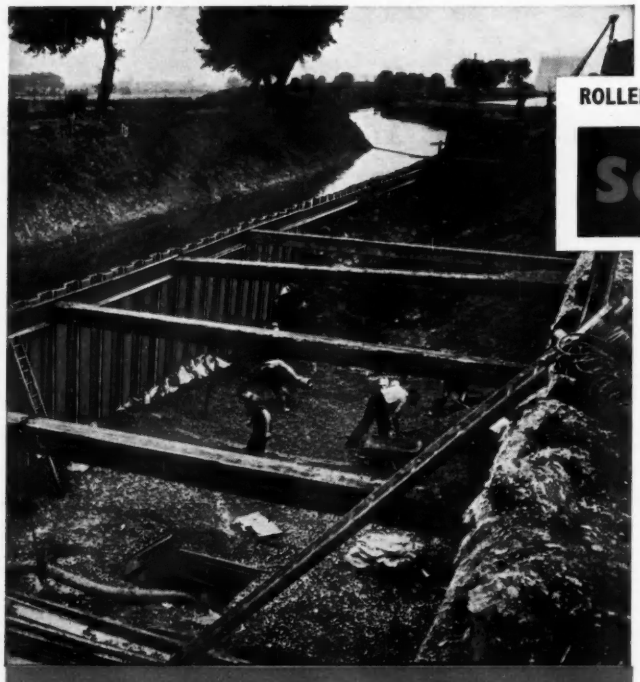
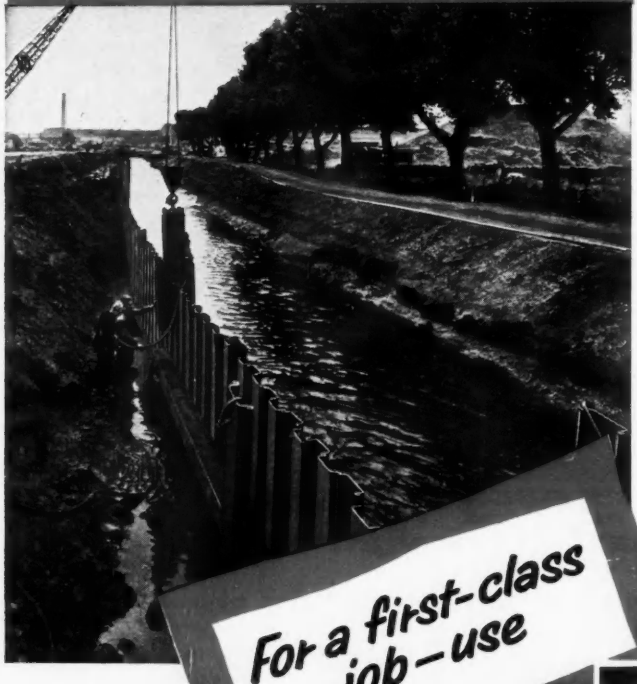


*Larssen piling in use in the Pymmes Brook Improvement Scheme for the Lee Conservancy Catchment Board. Engineer: N. Medrington, A.M.I.C.E., M.I.W.E. Contractors: Howard Farrow Ltd.*



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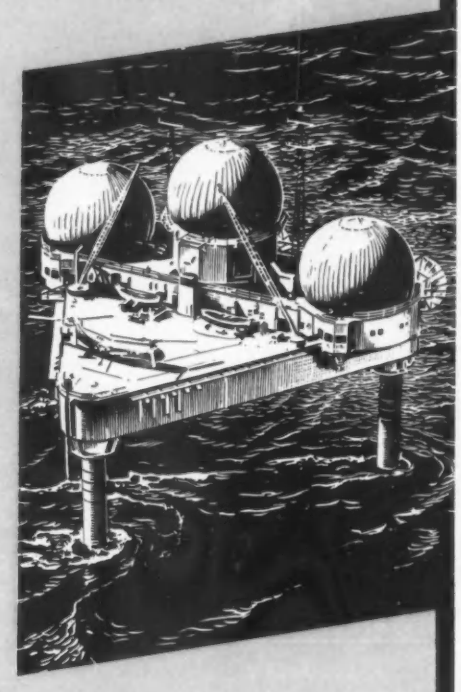

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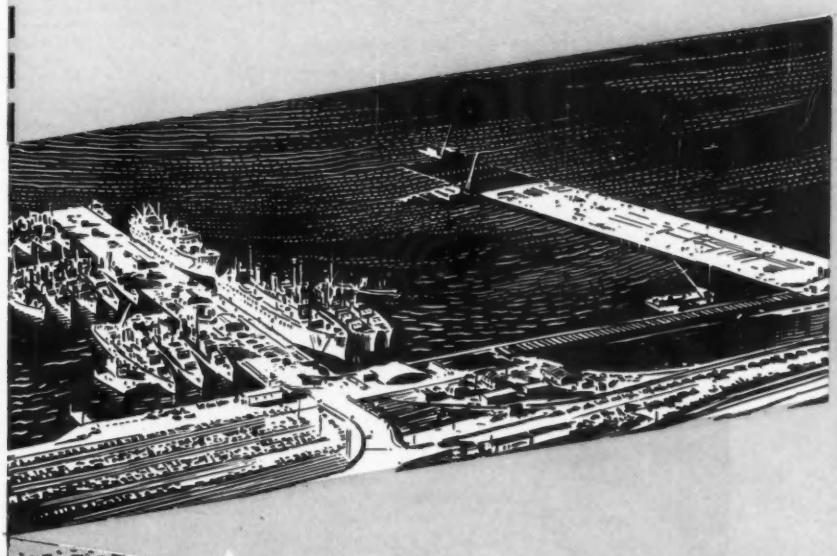

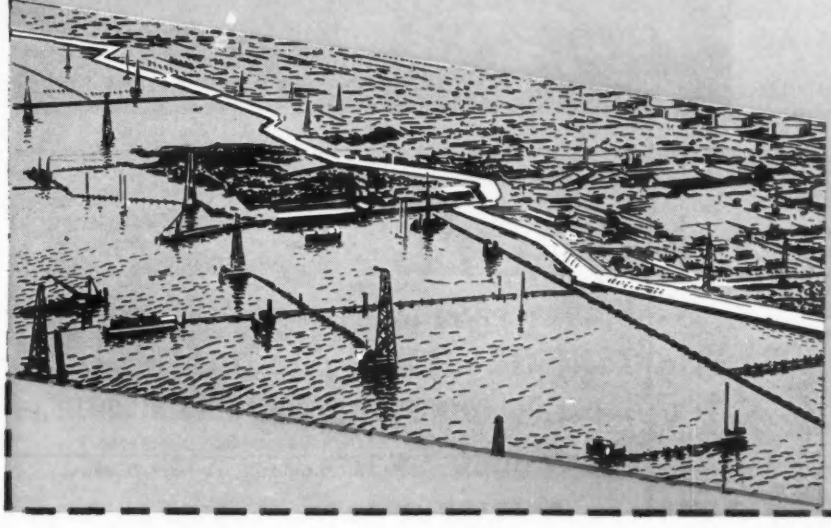

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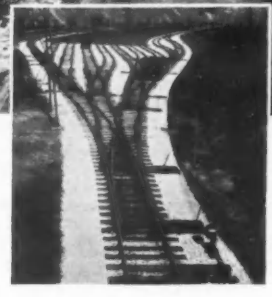

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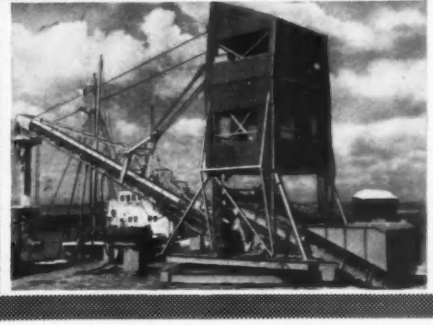

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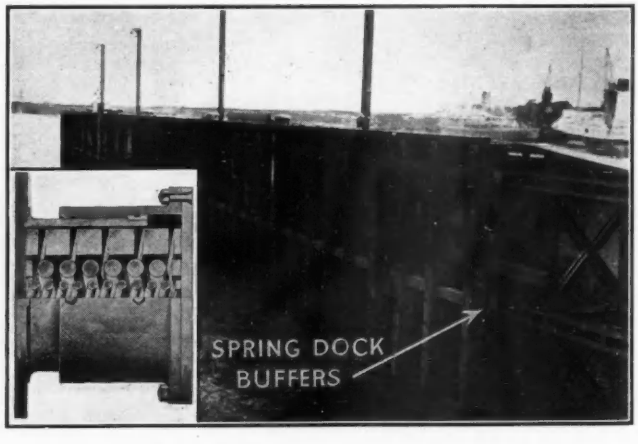


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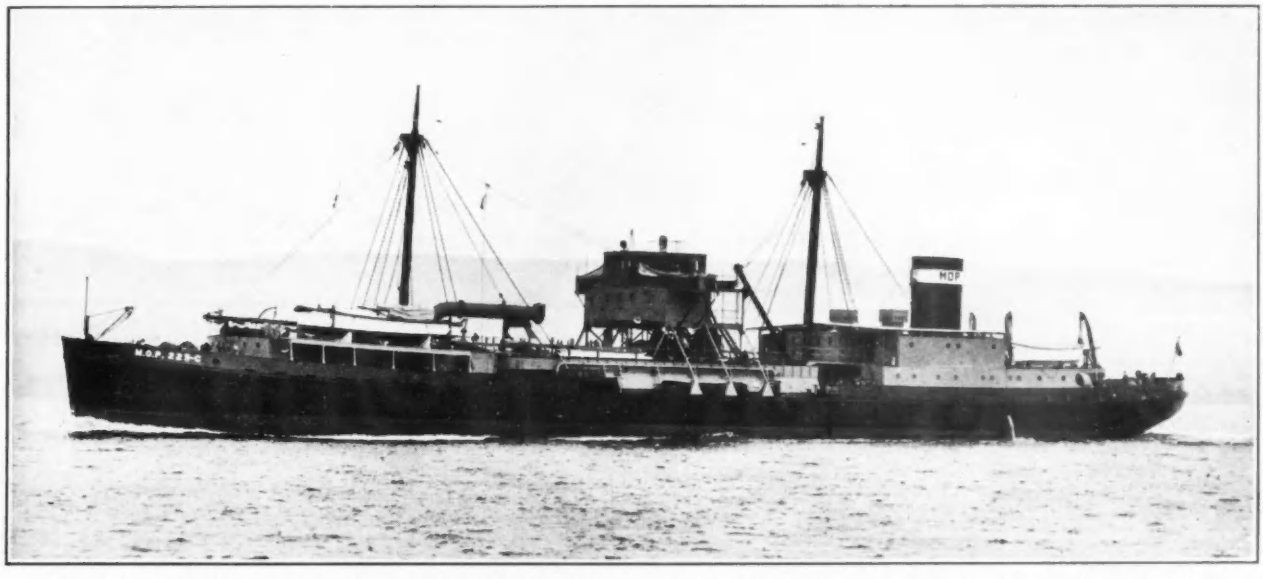

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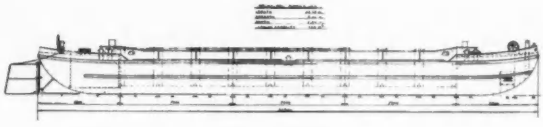

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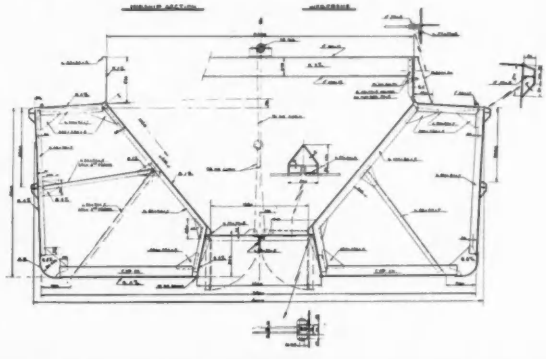


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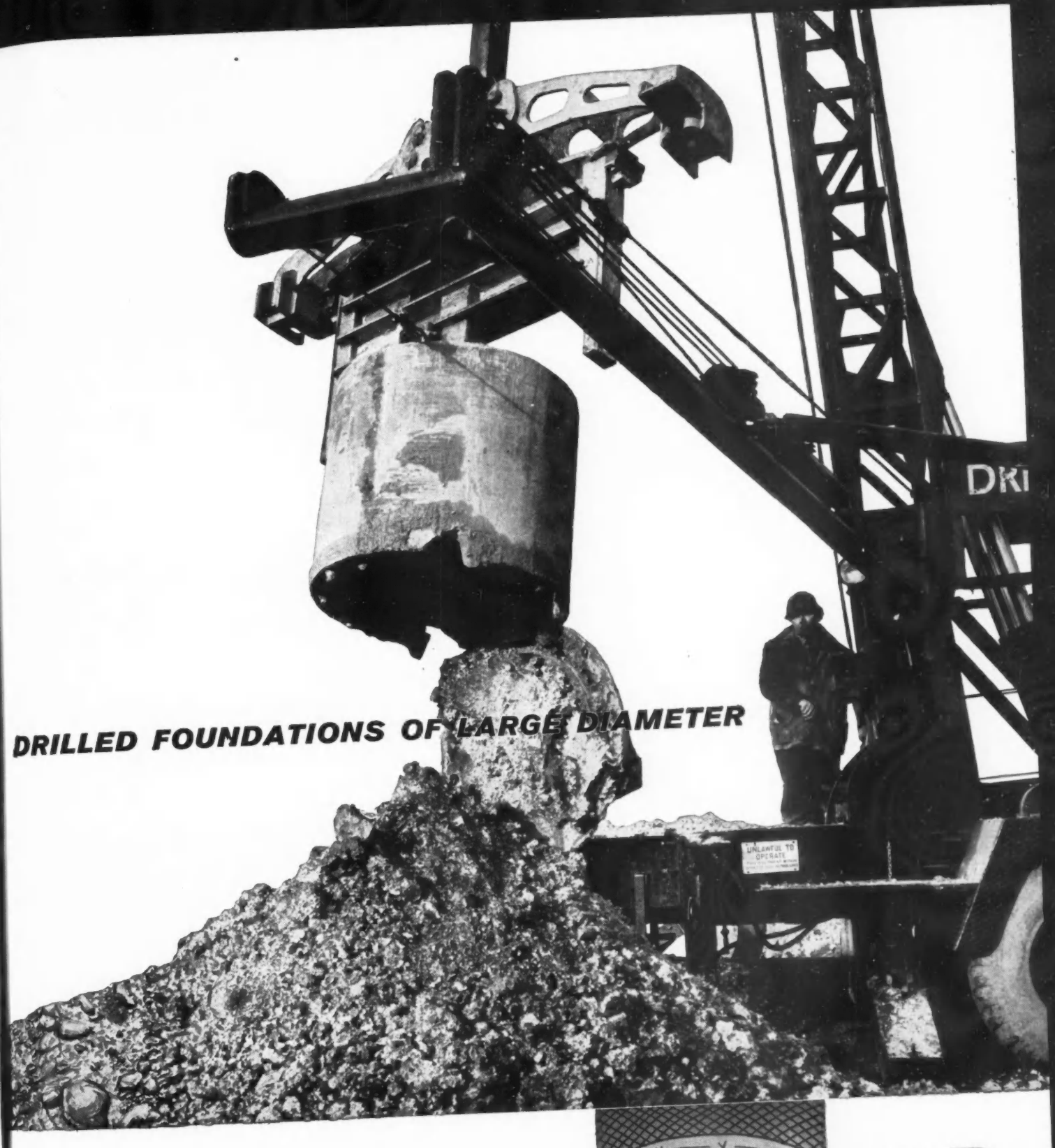


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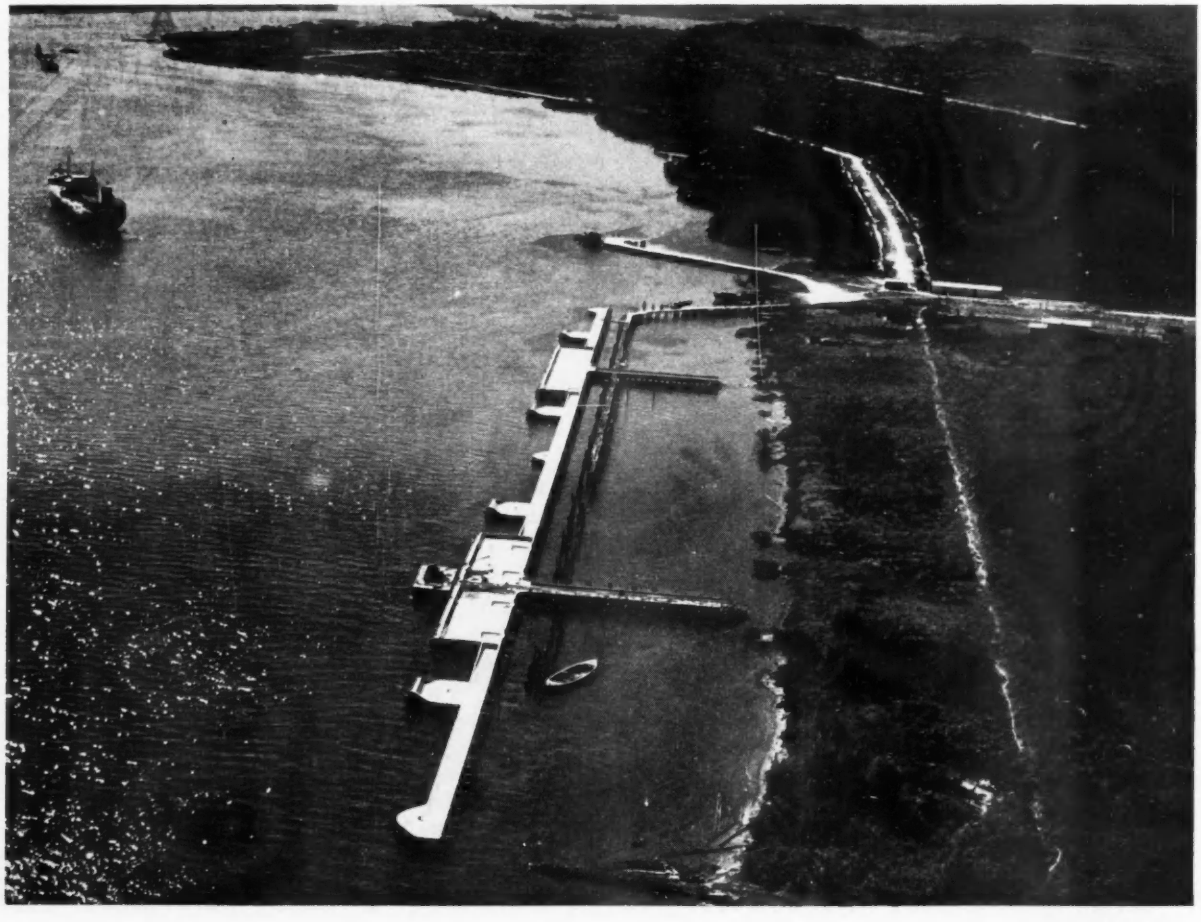

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